PUBLIC WORKS Magazine

Founded in 1896

Devoted to the interests of the engineers and technical officials of cities, counties and states

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W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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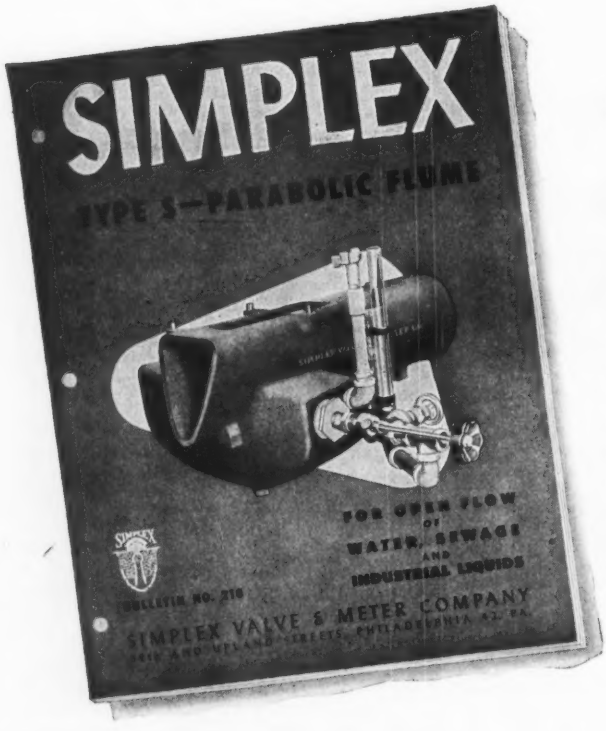
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The Editor's Page

Sanitary Engineering in the Army

Under this caption a few months ago we outlined the unsound and impractical plans of the Medical Department for the utilization of sanitary engineers in its proposed Medical Service Corps. Early in January, a group of engineers and scientists, including the writer, were invited to confer with the Surgeon General. The situation remains the same, including the fact that no prominent engineer or scientist has found it possible to approve the Medical Department plan.

A bill has been drawn for presentation by the War Department to Congress. This bill groups technical and non-technical men into a single corps, and provides no workable plan for utilizing technical men in their specialties, nor any opportunity for technical leadership. In essence, it insures a degree of mediocrity that will be a terrible handicap to our armies if we ever fight another world war. Also, it discriminates against technical men as compared to medical men.

We ask that every state and local engineering society pass appropriate resolutions condemning this plan, and forward these resolutions to their senators and congressmen. It it not possible at this moment to identify the bill by number; but it is believed that an appropriate resolution and letter, promptly forwarded to the state's representatives in Congress will be effective. Elsewhere on this page we urge our readers to help in national defense. There are few more important things that any of them can do for national defense than to help defeat this bill.

Later—Immediate Action Needed

The Medical Department bill to create a Medical Service Corps is HR 1982. This bill provides for merging sanitary engineers and other technical personnel with non-technical personnel in a single corps. It will insure less than mediocre sanitary engineering service in the army for the future. It is discriminatory in promotion. It should be defeated. Register your protest at once with your Congressmen. As regards the provisions affecting engineers and other technical personnel.

Army Day and Army Week

Army Day is April 7, and Army Week covers the period April 6 to 12. Many of our readers, at first thought, will not be interested in either one; they have had enough of the Army, and enough is enough. But we believe that a good many of them will be interested on second thought. The problem of national defense is a continuing one and we, as citizens, whether veterans or not, must continue to be vitally interested. We have previously urged all engineers to continue their reserve commissions; and, in addition, we urge that they take an active part in shaping the policies of our armed forces.

Most of the men who read this are technical men; many of them know by hard service and personal experience what the army needs in their technical specialty. National defense is not a responsibility solely of the regular army; it is a parnership affair for the highest stakes in the world. Partnership implies equality and responsibility. On that basis we again urge all of our readers to do their share in making and keeping this a strong America.

For Better Training and Opportunity for Public Service

The job of the health department is the protection of the health of the people. The job of the highway department is to construct and maintain highways and streets in such a manner as to facilitate industry and commerce, and contribute to the pleasure of the citizens. The job of a college is teaching and extension training.

Water and sewage plant operators, health department personnel and highway and street department employees need training in order to perform their duties better and to enable them to contribute more effectively to the general welfare.

In altogether too many states, cities and counties no training at all is being given to the public employees to permit them to perform their work better. In a few places, the state health department, the water department, or some other similar agency is attempting a training program, usually under many handicaps.

The state colleges have the facilities for training by means of short schools, abbreviated special courses, and extension work. Teaching is their business. A coordinated program of instruction in which the highway or health department outlines the subjects to be covered and the college does the teaching is the sensible course to better public service and increased returns to the state. Maybe this arrangement is in effect in some states; if so, we will be glad to know about it; if not, it is time to start.

To Build or Not to Build

Conditions surrounding construction have been, since the end of the war, an actual or potential embarrassment to many state, county and municipal officials. If plans are ready and money is available, but officials fail to provide some of the improvements so urgently needed, they may be subject to justifiable criticism from citizens, especially those most directly affected. As travel increases and traffic congestion becomes more acute, those responsible for highway construction may be in a position difficult to defend, if they remain inactive; and where sewage treatment to reduce existing stream pollution, or water works construction to promote the safety of the water supply, are necessary, a similar situation will arise. On the other hand, if contracts are awarded at prices that appear to taxpayers to be excessive, there may be a great deal of criticism. Most people do not expect prices to go back to pre-war levels within the immediate future, but it is concededly difficult for public authorities to determine the precise level of increase at which they may be justified in going ahead with the work or in postponing it.

And this is one time when we don't feel like offering much advice.

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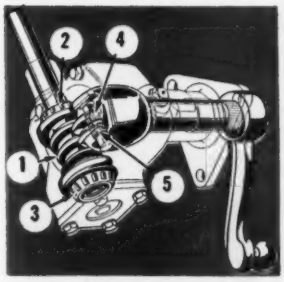
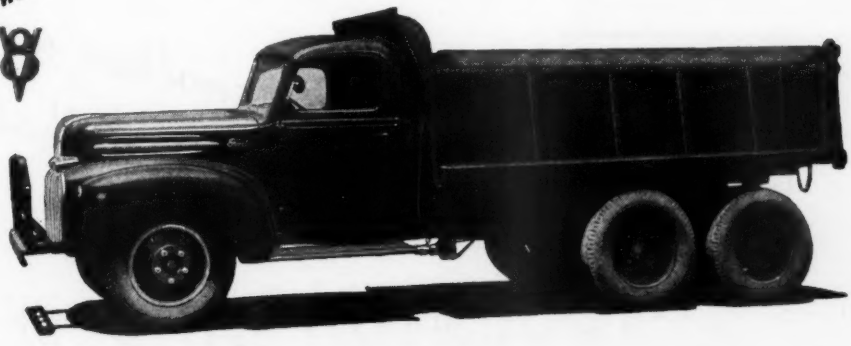


Ford

THE 6 YOUR PICK OF POWER THE V-8



A popular adaptation of the basic Ford heavy duty chassis —equipped with Fabco Dual Drive and 6-Yd. to 7-Yd. Dump body, now in service in Concord, California.

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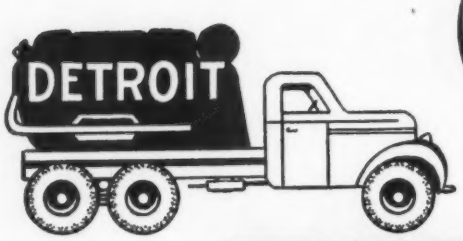

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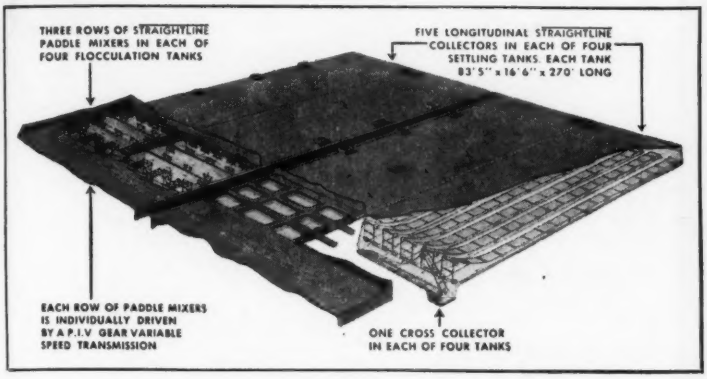
THREE ROWS OF STRAIGHTLINE PADDLE MIXERS IN EACH OF FOUR FLOCCULATION TANKS
FIVE LONGITUDINAL STRAIGHTLINE COLLECTORS IN EACH OF FOUR SETTLING TANKS. EACH TANK 83'5" x 16'6" x 270' LONG
EACH ROW OF PADDLE MIXERS IS INDIVIDUALLY DRIVEN BY A P.I.V. GEAR VARIABLE SPEED TRANSMISSION
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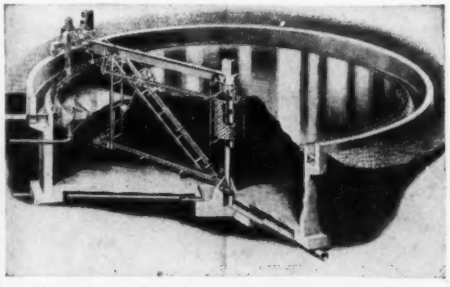
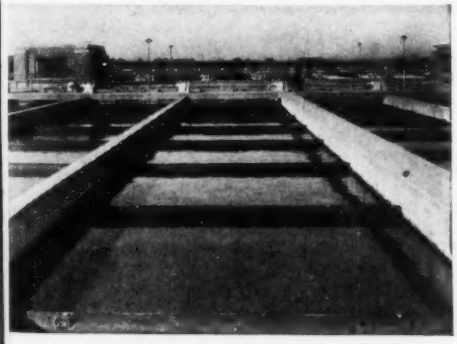
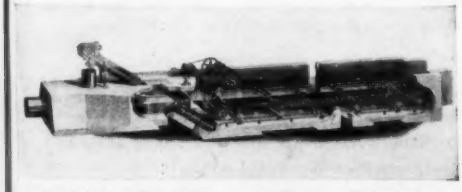


Circuline Sludge Collectors for the positive removal of sludge from round tanks. Send for Book 1982.



Straightline Sludge Collectors for the positive removal of sludge from rectangular tanks. Send for Book 1742.



Straightline Grit Collector and Washer. Effectively collects, washes and removes settled grit and separates it from putrescible organic matter. Send for Folder 1942.

CONSULTING engineers, public officials and operators of sewage treatment and water purification plants, have long known that Link-Belt screens, sludge collectors, mixing, aeration, conveying and driving machinery, are durable, dependable and economical. All Link-Belt equipment is engineered and manufactured in our own plants. It is built to last and to operate at maximum efficiency. Send for catalogs.

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Lock Joint Pipe Company has applied the principles of prestressing steel in tension and concrete in compression in the design and manufacture of Lock Joint Prestressed Concrete Cylinder Pipe.

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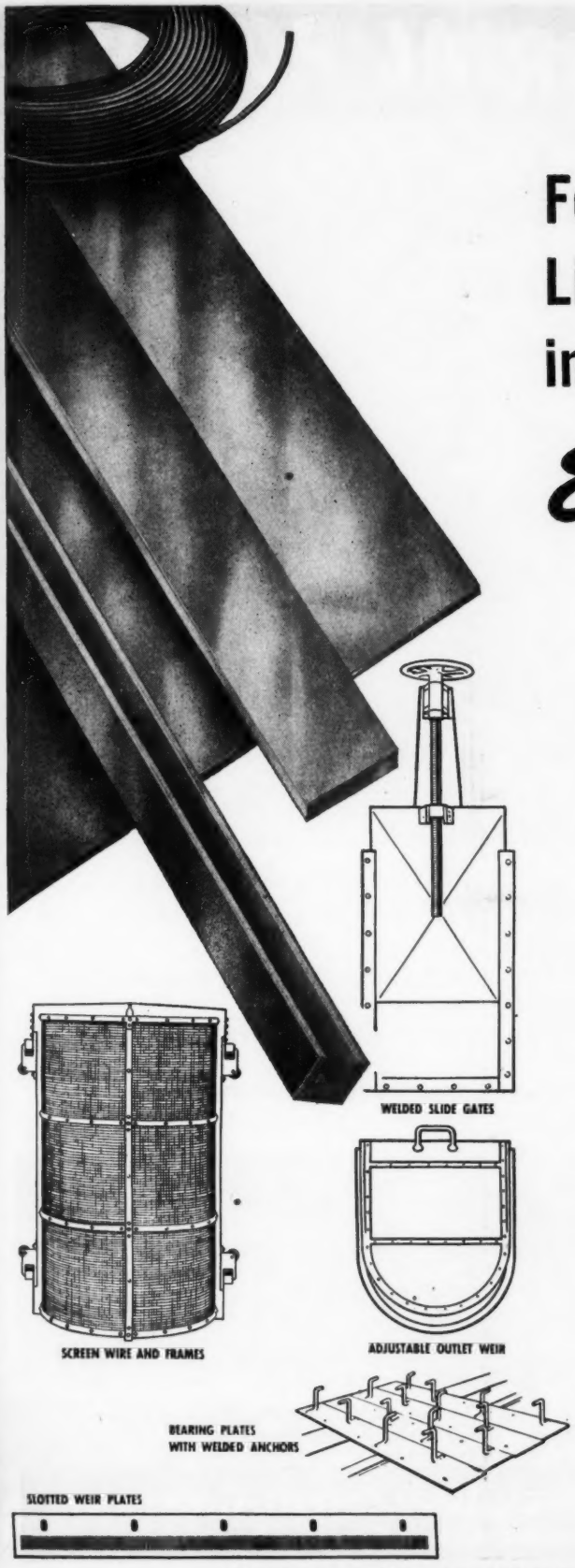

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MM Minneapolis Moline MM Modern Machinery

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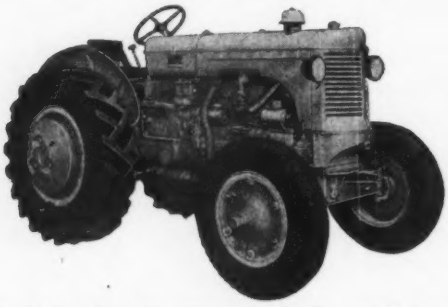

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UTI Tractor With 22′ Front End Lift

MM Industrial tractors are modern, economical, safe, and long lasting.

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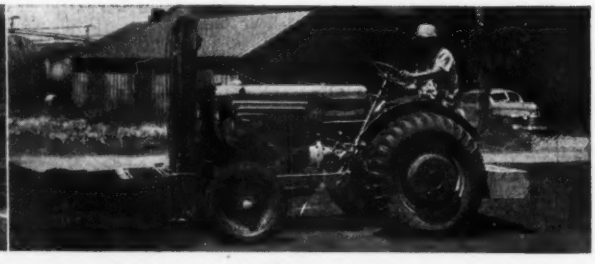

RTI Tractor with front end shovel loader attachment

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GATX GENERAL AMERICAN

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THE FLOCSETTLER — a combination water conditioning unit, consisting of a rapid mix zone, a gentle agitation zone, and a vertical settling tank. The floc bearing water flowing upwards through the sedimentation compartment diffuses through the downward settling slurry. This unit is effectively applied in all cases where it is desirable to use a blanket contact, vertical flow settling tank for turbidity removal, cold water softening, or removal of suspensoids from wastes. Because of its simplicity of operation, it is well suited for municipalities, institutions, camps, and industries. *Bulletin No. 256.*

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PIONEERS IN PUMPS

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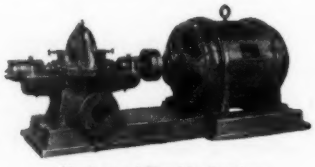

Horizontal Double Suction

Split case, ball bearing design. Enclosed type bronze impeller with all water passages hand finished and exterior surfaces machined. *Bulletin No. 248.*

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Inquiries on new installations and improvements in existing plants will receive prompt attention. Send us a one-gallon sample of the water to be treated. On the basis of our laboratory's analysis and the bacteriological tests made by your State Board of Health, our Sanitary Engineers can cooperate with consulting and operating engineers in suggesting the process of treatment and the type of equipment required.

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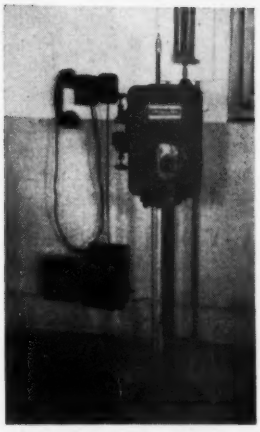
Pump Equipment

How to plan and provide for the many important controls, electrical equipment, chlorinators and other items that make a good job.

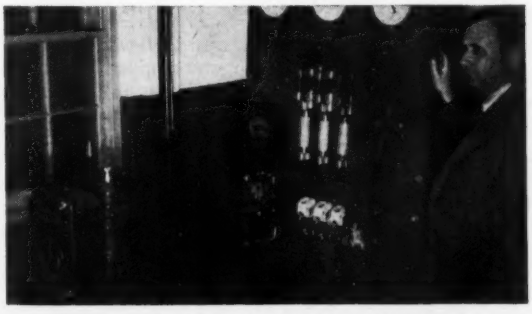
By FRANK E. HARLEY
Harley and Garlick, Consulting Engineers



Signals are transmitted over telephone lines by this flow meter.

AFTER the pump specifications have been prepared, consideration must be given to the items of equipment that are to be included in the pump contract. If the pump is to be automatically operated, it is essential that the pump contractor furnish and install this equipment, making one party responsible for the entire equipment. As far as the flow meter and chlorinator are concerned, these pieces of equipment are so specialized that it is better to have them installed by the manufacturer or his sales distributors.

It is generally advisable to consult with the power company engineers—if electric drive is the source of power—on the size of cable, conduits, type of switches, circuit breakers, and other equipment specified; and also to determine just what equipment the power company will furnish besides the meter. Does the customer furnish the meter board? And, if so, what size, materials, how made, and recommendations for its installation? Do they furnish the entrance switch or a circuit breaker? Should it be a fused knife switch and what size and capacity is recommended? Must it be enclosed? Perhaps it is also necessary to have a small transformer on the meter board to step down the voltage for the lighting and heating circuits. What is the type of starting equipment for the motor? In many cases, across the line starters can be used on fairly large motors, even up to 100 HP, providing they do not cause too great a surge in the line of the domestic users in the vicinity of the pump installation. Otherwise an automatic motor starter will be required.



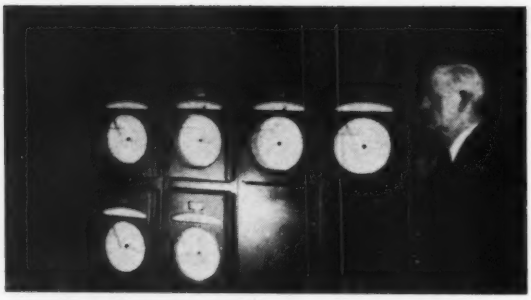
The author shown by automatic control board. Manometer registering flow and transmitter of flow meter can also be seen.

Control Board

After the details of the meter board have been determined the panel control board on which all operating equipment and gauges should be mounted must be considered. It is generally advisable to have one built by a company specializing in this line of equipment, rather than to rely on a home-made affair. The board can be of bakelite, slate, or other similar material. It should be self-supporting and self contained, and constructed so that all "live" equipment is protected against accidental contact; that is, it should be a so-called "dead face" board. The rear of the panel should be completely protected and provision made to "kill" the board completely when it is necessary to work around it, and particularly in back of it. The board should be provided with a fused switch or circuit breaker to cut out all the equipment on the board at one operation. The power company and the insurance rating office inspectors will advise the clearance to leave between the wall and the panel.

Automatic Pump Controls.

The automatic starting and stopping controls that actuate the motor starting switch are generally made up with a bourdon tube assembly, connected to the relay that controls the starter. This starter can be adjusted within certain limits. In locating the water line from the main to this control, it is advisable to place it far enough away from the pump so that the pump operation does not affect it. This distance may be fifty feet or even more. The automatic control will be furnished with a switch that will cut out the automatic operation and permit manual operation. It is advisable also to provide for a time delay, so that when the pump stops from either a surge in the water line or by power fluctuations, the restarting of the pump will be delayed until a certain time interval has elapsed. This may vary from a matter of seconds



Supt. Frank Knapp of the Fairlawn water dept. checks recorders registering flows at distant well houses.

up to 20 minutes or even longer, and can be adjusted to suit the best operating conditions after the pump is in service. This permits the well to build up when the pump stops, and by giving the well a chance to recover it does not throw such a heavy load on the motor when restarting. It is desirable to install an automatic cutout that will cut the pump out of operation beyond the maximum pressure on the automatic controls, in case of failure of the latter. This cutout should be set to operate from five to ten pounds above the top limit of the automatic control. When the cutout throws the pump out of operation, it is necessary for the operator to re-start the pump, at which time he should check and find out the cause of stopping. There is also equipment available to cut the pump out of operation in case the water is drawn below the suction limit of the turbine.

The very modest cost of these various controls is surprising and their advantages far outweigh their small original cost.

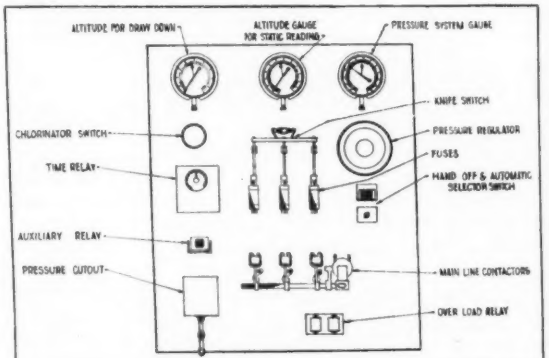
In providing for the complete installation of equipment with the pump, it is generally necessary to include all the electrical work from the point of delivery of the current by the power company. This means the contractor must supply and install all of the equipment on the meter board but the meter. From the meter board, necessary cable connections must be run to the automatic panel switchboard, then to the motor pump, and to other auxiliary equipment.

Gauges and Other Accessories

In order to provide data on static level and drawdown it is necessary to have an air line or other means of determining the level of the water. After trying to find the static level in an air line filled with several hundred feet of water by pumping until blue in the face, it has been found very convenient to have two air lines inserted in the well. One may be about twenty to forty feet below the usual static level, with the other line to determine the working level, say about ten or twenty below the turbine. These lines are usually of ¼" copper tubing or brass pipe. They are best fitted with gauges marked in feet; the static gauge can be graduated in a range to suit the expected static level, while the working level gauge should, of course, be graduated to cover the full range. Whether to have these gauges read the depth of water directly, or use standard graduations requiring mental arithmetic to find out how the water is standing can be made according to the engineer's wishes. It is advisable to know discharge pressure of the pump, and this gauge can also be mounted on the panel board. This can be attached close to the pump. The loss of pressure through the pump discharge line and the check and gate valves can be easily found by comparison with the system pressure on the automatic controls.

In specifying gauges it is generally advisable to call for not less than a 6-in. diameter face for easy and accurate reading. The difference in cost between the larger and smaller gauge is nominal and well worth the slight increase. As gauges are likely to get out of order, and also vary in accuracy, it is well to have them equipped with a re-calibration screw to correct errors. Every waterworks plant should have a dead-weight testing set to check the accuracy of the various gauges from time to time. This is particularly important in making efficiency tests, for an inaccurate gauge may throw out the entire result of the tests. If the testing gauges are calibrated on a testing set, corrections can be made for inaccuracies in these gauges. As surges may cause the gauge needles to vibrate badly it is desirable to have each gauge equipped with both a gauge cock and a snubber. The snubber is a small device that fits below the gauge, and by a floating piston smooths out the shocks and saves wear on the gauge. These snubbers may also be used with the automatic control, if trouble is experienced with varying pressures that can not be smoothed out by locating the control in the main far enough to avoid the influence of the pump.

To prevent water hammer, a balanced check or a cushioned check valve, or hydraulically operated check, may be used instead of a swing check. Good results are obtained with either the balanced or cushioned type. However, unless the pump is equipped with an air release valve, these valves do not eliminate all slam. A particularly vicious slam occurred when starting a pump with a cushioned check valve, violently swaying some of the fittings on the chlorinator eight feet away. Putting in an air release valve to permit release of all the air in the pump from the static level up to the pump discharge when the pump started cured this trouble immediately and a smooth starting pump was insured. The air relief valve was merely a 1" swing check valve, mounted upside down, and run on an angle. When the pump was stopped this acted to prevent back pressure when the water in the column of the pump ran back into the well. At the same time this air release valve prevented air being pumped into the system on starting, causing "white water" and perhaps some trouble in the distribution system by creating air pockets in the summits of the system. In another pump installation, when the air relief valve was temporarily capped, the pump on starting built up a considerable pressure before forcing the balanced check valve open, which raised the pressure enough to force the automatic control to shut the pump off.



Typical layout of an automatic board.

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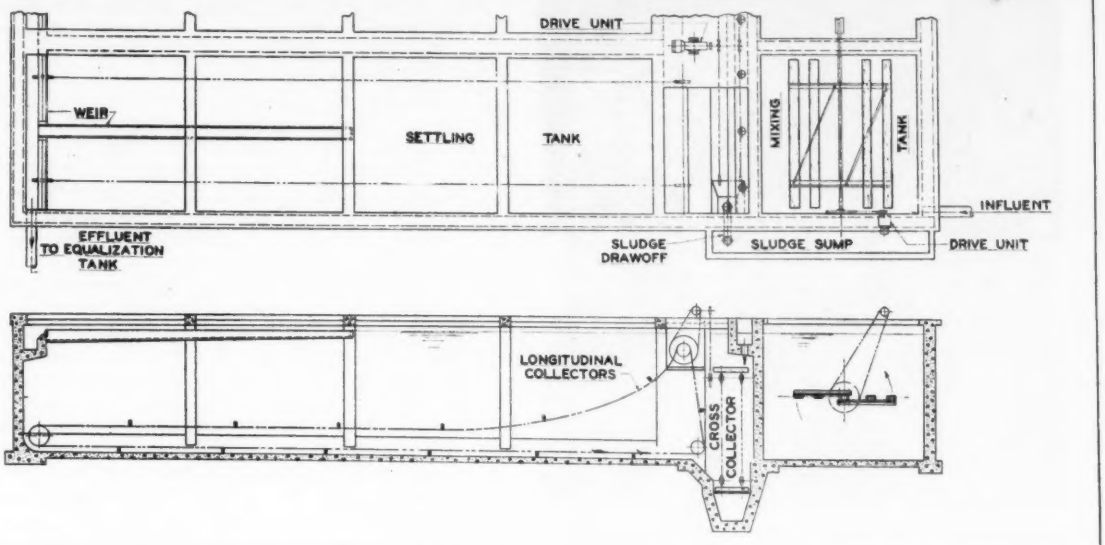


Section and partial plan of settling and mixing tanks.

An Effective Tannery Waste Treatment Plant

Flocculation, sedimentation, and flow equalization utilized to provide treatment acceptable to State Department of Health.

By H. T. REUNING, Sanitary Engineer, Keystone Tanning and Glue Co., and R. F. COLTART, Sanitary Engineer, Link-Belt Co.

THE Keystone Tanning and Glue Company, several years ago, pioneered in the construction of industrial waste treatment plants for their tanneries at Ridgway and Wilcox, Pennsylvania. The recent installation at their Eagle Valley Tannery at Ridgway has several unique and successful features. This tannery produces sole leather using the vegetable tanning process. The effluent from the waste treatment plant is discharged into the Clarion River.

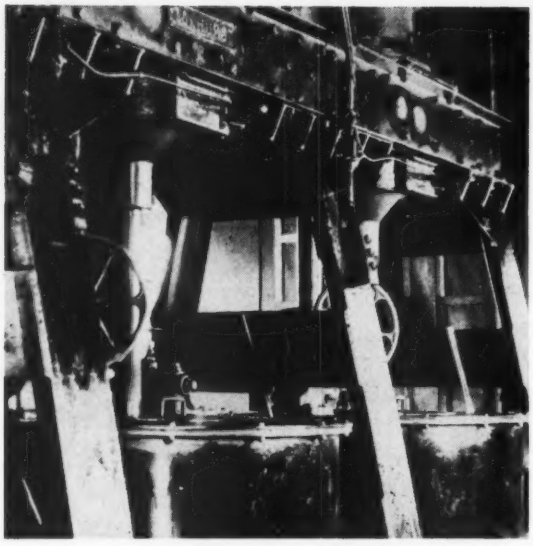
Flow.—Waste waters from the beam house, scrub house, and finishing department are collected in two sumps. Approximately 85% of the total flow is from the beam house and the pH of the combined wastes varies from 11.0 to 12.0. Two 3-inch centrifugal pumps, operating eight hours per day, pump the wastes to the treatment plant. The pumps are float controlled and the average flow to the treatment plant is 35,000 gallons per hour. During peak operation the maximum pumping rate is 50,000 gallons per hour.

Design.—The treatment plant is designed for mechanical flocculation of these wastes, sedimentation in a mechanically cleaned settling tank, flow equalization for uniform discharge to the receiving stream and mechanical sludge dewatering and handling facilities. The spent tan liquors are evaporated for recovery of salable by-products.

On entering the treatment plant the wastes are flocculated in a mixing tank 16′0″ wide x 13′0″ water depth x 33′0″ long. At the average flow rate of 35,000 gallons per hour a theoretical detention period of 1½ hours is provided. The mechanical mixer consists of three sets of redwood paddles mounted on a horizontal shaft arranged parallel to the liquid flow through the tank. The peripheral speed of the paddles is proportioned for maximum flocculation of the fine suspended solids. A processed malleable iron chain drive connects the paddle shaft to the motorized helical speed reducer mounted on top of the tank.

After flocculation, the waste passes to a settling tank 33′0″ wide x 13′0″ average water depth x 70′0″

View of plant showing settling and mixing tanks in foreground, flow discharge equalization basin at right and sludge dewatering building in left background.



Centrifugal sludge dewatering machines.

long. This tank is equipped with two logitudinal and one cross sludge collector for moving the settled solids into a hopper in one corner of the tank. Each conveyor consists of a double strand of 6" pitch processed malleable iron chain operating over three sets of sprockets. Redwood flights are spaced on ten foot centers on the longitudinal collector and on 5'0" centers on the cross collector. The conveyors operate at a speed of about 1 foot per minute. One special motorized reducer with three output shafts is arranged to drive the three collectors. The average theoretical detention period is 6.5 hours.

The effluent from the settling tank passes to a flow equalization basin with a storage capacity of 370,000 gallons. Two swing-joint float-supported effluent pipes are used to withdraw the treated waste from the basin through a float-controlled valve and orifice box at a uniform rate throughout a 24-hour day.

Three 40-inch solid wall, basket type, suspended centrifugals are provided for dewatering the settling tank sludge. Each one is powered by a 15 HP direct-connected, 1200 rpm motor.

Operation.—The various wastes which are discharged intermittently are thoroughly mixed and flocculated in the mixing tank. The mechanical mixer is run continuously throughout the period the tannery is in operation.

Due to the fact that it requires 16 hours per day to centrifuge the sludge, the sludge collectors must be operated for this period each day. During normal operation a sludge blanket about 12 inches deep is maintained in the bottom of the settling tank to permit as heavy a solids concentration in the sludge as possible. The sludge is wihdrawn through an adjustable decanting pipe into a storage sump from which it is pumped to a flow distribution box. From this box the flow is delivered to each of the sludge dewatering machines at a rate of 15 gallons per minute. A complete operating cycle requires sixty minutes. The sludge from the centrifugals is elevated to a watertight dump truck outside of the building.

Results.—The suspended solids of the plant influent average 2,500 parts per million. An average of 250 parts per million suspended solids are found in the final effluent discharged to the river. This represents 90% reduction, but on the basis of 24-hour discharge, a reduction of 96% in suspended solids loading on the stream is obtained.

The five day Biochemical Oxygen Demand of the plant effluent averages about 350 parts per million. The actual tannery discharge handled in the treatment plant contains approximately 600 parts per million BOD, but if the spent tan liquors were taken into consideration this would amount to about 1200 parts per million.

If credit is taken for the elimination of spent tan liquors by evaporation and a 24-hour uniform instead of 8-hour intermittent discharge the total 5-day BOD reduction can be considered at 90%.

The centrifugals discharge about 2500 gallons of 85% moisture sludge per day. This represents about 10% of the volume of sludge received from the settling tanks. The sludge is disposed of by dumping in a low area on the tannery property. It makes excellent fill and no objectionable conditions are created. The discharge from the centrifugals is mixed with the untreated wastes and is resettled in the settling tank.

The plan was designed through the close cooperation of Keystone Tanning and Glue Company and Pennsylvania State Department of Health Engineers. This installation was one of the first mechanical tannery waste treatment plants in the state and the design factors used have proven to be adequate.

This plant has demonstrated its efficiency both in operating results and low cost of maintenance. The results have been well within the requirements set up by the Pennsylvania State Department of Health.

Water Main Repaired by Welding Without Discontinuing Water Service

By ANDY MILLER

While working for the Jersey City Welding Company, Jersey City, N. J., I was called out to repair a city water main in Bayonne, New Jersey, that was leaking badly. We were asked to repair the main, if possible, without having the water shut off.

To accomplish this job, without shutting the water

Repairing water main filled with water.

off, I whittled a wooden plug to the size of the hole in the main and drove it in until it was tight. I then sawed the plug off even with the outside of the pipe. This plug stopped the leak and enabled us to weld a 6" diameter plate over the bad section, making a permanent repair. The photo shows the plate being welded to the main.

The data and photo are published through the courtesy of the Hobart Brothers Company, Troy, Ohio.

Inventory and Stock Control for City and County Public Works Departments

Although written primarily for sewage plants, the practices outlined in this third installment of a paper presented at the British Institute of Sewage Purification apply equally to highway, street and water departments.

By W. F. FREEBORN and A. A. KIRKBRIGHT
West Midllesex Main Drainage Works

Trucks and Transportation

The number and class of vehicles will naturally depend on the volume of work. Light trucks of the dump type are usually provided because of their general handiness, but if care is not taken there is a tendency to overload them, particularly where heavy machinery parts have to be transported, and increased maintenance costs result. In many cases, the increased capital expenditure on a 2- to 3-ton truck as against a 1½ ton type will be saved in lower maintenance costs.

The combined driver-mechanic is rarely economical, and wherever possible a properly trained mechanic should be employed on maintenance, with systematic inspection at regular periodic intervals. Prevention of breakdown rather than cure should be the keynote and drivers should be encouraged to point out slight defects as they occur.

For general use in dealing with light loads, say, not exceeding 10-15 cwt., a mobile crane is very useful and has the advantage of being capable of operation by one man. These cranes may be entirely hand operated, but the increased mobility and rapidity of movement which the power-driven type affords usually more than justify the additional initial cost.

Ancillary Services

Roads, Walks, Hedges and Gardens.—The lay-out and types of construction of roads and walkways, and the treatment to be accorded to areas of land and embankments not essentially a part of the purification plant, require consideration coincident with the design of the works.

Too often the purification plant is built with no capital provision for the cleaning up of the site, and the works manager is left to try to make the whole establishment neat and tidy on what little money and labor he can scrape together annually after the needs of the treatment plant have been met—a slow and unsatisfactory procedure. An untidy works is rarely an efficient works; the "anything is good enough" attitude easily infects and undermines the mental outlook of the whole establishment. Obviously the nature of the traffic will determine the construction of roads and footpaths, but it is well to bear in mind that any saving in first cost by laying, say, a gravel or cinder road, will probably be soon spent in annual maintenance.

Every sewage works will have areas which should be planted with trees and shrubs or grassed. There should be sufficient co-operation between the several departments of the municipality for the services of the park superintendent to be made available as adviser on the initial lay-out and planting of these areas. It is not expected that the horticulture of the sewage works shall be up to the standard of the public parks, but with a good start there is no reason why a high standard should not be maintained at very little cost.

Fairly level grass plots can be kept tidy and pleasing to the eye by frequent cutting, and no great expense is involved if suitable power-operated mowers are used. Steep grass slopes are very difficult to deal with in this respect, however, and they should be avoided if at all possible. Again, there should be an eye on future maintenance costs when deciding what shrubs shall be planted. For example, privet will make a good hedge at small cost in a very short time, but the annual cost in clipping is not small.

A further point on the lay-out of roads and walks is that a nicely planned lay-out is often nullified in practice because people will not keep to the footpath if a few yards can be saved by cutting across a plot. A path laid in a straight line between two points may not look well on paper, but in practice will give a better appearance than a well-designed but little-used path with an area a few yards away disfigured by a track worn by pedestrians taking a "short cut."

Welfare and Amenities

It is accepted that local authorities should be among "the first flight of good employers," and as such they should keep at least abreast of the best industrial practice in the provision of welfare services for their employees. In planning or replanning any municipal plant, the following should be considered:

Cloakrooms.—Space should be allowed in design for the provision of adequate cloakrooms. Each employee should be provided with a locker (preferably steel) for his personal use, of which he alone should hold the key, each locker being identified by a card bearing the employee's number or name. In addition to cloakrooms, means of drying wet clothing may be necessary. A separate drying room should be fitted with heating pipes or radiators about which clothing may be suspended on pegs or hangers. Ample space should be provided in the cloakroom for the maximum number of employees to move freely. A water supply with short hose attachment should be provided in the

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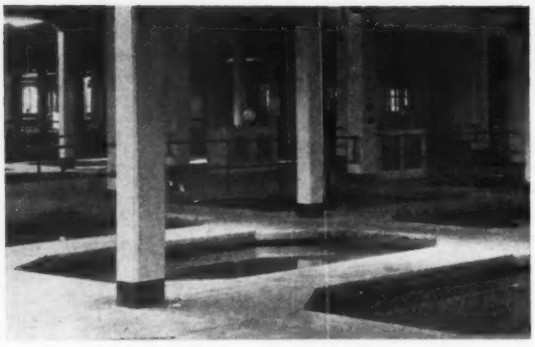

Type of the forms used in Baltimore.

Preventive Maintenance

Proper maintenance of equipment will save many headaches. Check the data in this article against the practices in your plant.

INSOFAR as possible, equipment of standard manufacture should be used. It is recognized that a skilled mechanic can replace and improvise parts that are just as good as those furnished by the manufacturer. However, when an accurate time record is kept, it is believed the cost of making major replacement parts is greater than if purchased from the manufacturer of the original machine. Home made parts should only be utilized in an emergency, and such practice should not be unduly encouraged.

"After a machine has been in service for an extended period of time and repairs have become excessive and costly, a prejudice slowly develops in the operator's mind toward that piece of equipment. In a short time the attitude is assumed that it is not worth trying to keep in condition, and it is, therefore, considered worn out and ready for the junk heap. . . ." "There should never be laxity in replacement or repair to machinery, . . . provided that when properly repaired or parts replaced, this efficiency is equal to new."[1]

There are many factors which must be considered when establishing a maintenance program in a water purification plant. The size of the plant is a major consideration. Although of standard manufacture, much of the equipment is of such a special nature that only general statements of service conditions may be made.

In the small plant with only one man per watch, his time will be taken up by operating details. Under this condition, repairs and preventive maintenance must be accomplished by a mechanic employed for this purpose or with help from outside the plant organization. In the large plants, a trained maintenance force should be kept available and supplied with the necessary equipment to accomplish all repairs, except on the very largest type of machinery, without outside help.

Operation of machinery conforms to basic principles whether it is in a water plant, power station or industrial establishment, and the same rules will apply. Frequent inspections, cleaning and testing will save many times their cost in reduced repair expense. Even when routine greasing and oiling is done by the operator, these items should be periodically checked by the maintenance force. A grease cup or an oil hole may be missed and cause excessive wear or a breakdown. Complete assembly drawings of all equipment should be available so that it will not be necessary to dismantle a machine to see how it is built. These drawings will also facilitate the replacement of new parts and make it easier to dismantle a machine. The oil and grease in all bearings must be renewed periodically. When dirty, the bearing should be flushed before replacing the lubricant. This replacement is desirable at frequent intervals and is determined by the condition under which the machine is operating.

Pumps, Motors and Engines

With the use of centrifugal pumps having few working parts, maintenance is reduced to a minimum. It is advantageous to make occasional efficiency tests to determine leakage through wearing rings. These tests may be performed by use of the regular line meters and gauges. Shaft packing should be inspected regularly and kept tightened to the point where there is but slight leakage. This keeps it cool and in good condition. Packing should be replaced before it becomes hardened or damaged so as to cause excessive wear on the shaft. Never restore old, hard packing to a stuffing box. Operators, by learning to recognize normal running sounds, are very helpful in detecting abnormal conditions often reflected in the "whine" of the pump.

Control apparatus for starting and stopping pumps are activated by pressure, float and contact devices. These may be electric, pressure or mechanically operated. Preventive maintenance, as outlined by the manufacturer, must be strictly complied with.

Most plants operate by electricity. Electric motors with proper maintenance will last indefinitely. Dampness is normal in a water plant so periodic checking of wiring, motor and other electric equipment for

City of Baltimore
Department of Public Works
Bureau of Water Supply, Filtration Division.
INSPECTION AND REPAIR RECORD

Building or Equipment _____

Date	Description of Work Done	Material Used	Total Cost

City of Baltimore
Department of Public Works
Bureau of Water Supply, Filtration Division
DAILY WORK CARD

Name _____ Date _____

Building or Apparatus	Work Performed	Material Used

Two of the forms used in Baltimore.

Water Purification Plant

By EDWARD S. HOPKINS, Associate Engineer, and
A. A. BAILEY, Junior Associate Engineer
Bureau of Water Supply, Department of Public Works, Baltimore, Maryland

grounding or shorting must be made. The installation of electric wiring, unless lead covered, in conduits is a constant source of trouble under these conditions.

The air gap of electric motors should be checked at frequent intervals to determine bearing wear. Prompt replacement of motor bearings will save costly repair bills. The current consumption of each motor should be recorded. A comparison will determine variance of motor load caused by changes in equipment or binding of working parts. These conditions may throw an overload on the motor, while not heavy enough to blow the fuse or trip the relay, will in time cause the motor to fail, primarily due to over heating.

As in pump operation, unusual noises, failure to reach speed, vibration or odor of hot insulation, if reported by operators, are basic cause for immediate inspection.

Normal maintenance is to keep all bolts holding rings and nuts tight to frame and block. The exhaust manifold, pipe connections, oil pan and other fittings must be regularly inspected and kept tight. The battery charge and water are important maintenance items. This type engine is similar to that of a motor car. It should be given like care. The manufacturer's specifications for maintenance must be rigidly adhered to. Diesel engine maintenance is similar to gasoline engines and the same basic principles apply.

Belt and Chain Drives

Maintaining proper tension and alignment of belts will give longer wear. Incorrect alignment causes excessive friction and poor operation. Inadequate tension reduces the belt traction. To prevent deterioration, keep belts and sheaves clean and free from oil. Oil may be removed by wiping the belt with a rag moistened in gasoline or carbon tetrachloride. After cleaning with a solvent or if a belt becomes dry, it should be treated with belt dressing to renew the pliability of the leather. Before installing belts, worn or damaged sheaves should be replaced and adjustments slacked off. Belts should not be forced into position with screwdriver or pinch bar; they should be replaced when frayed, worn or cracked. Do not replace a single V belt on a multiple drive; replace the set. Compliance with the manufacturer's specifications as to proper installations and care of all belts, pulleys, etc., is important.

Periodic check should be made of alignment and excess wear that may occur in chain drives, and of looseness over the sprockets. These factors may cause the chain to ride on the top of the teeth instead of meshing properly. As with belts, the manufacturer's installation specifications must be followed.

A portion of the operating gallery at Baltimore's filter plant No. 1.

Valves and Their Maintenance

Improperly maintained or neglected valves may be a source of much trouble in a plant by leaking, failure to close properly or "freezing" shut. They should be inspected for cleanliness and stem wear, worn nut threads, and hard or disintegrated packing. Periodic manipulation of infrequently used valves is necessary and a record of this operation should be kept. When operating with hydraulic valves, excessive discharge from the cylinder indicates wear on cup leather or packing failure. Leakage through a valve should be checked by visual inspection, observation of line gauges or aquaphone tests. When excessive, the seats and discs should be "trued up." This may be satisfactorily accomplished with a Dexter type valve reseating machine for globe or parallel seat gate valves.

Chemical Equipment and Chlorinators

Chemical control devices are the most troublesome of all plant equipment. They are not only subject to ordinary wear but also to chemical corrosion and deterioration. Close, frequent checking of all parts of this machinery is necessary. Duplicate machines must be available for immediate use since there *cannot* be any interruption to this vital operation. Also, a supply of replacement parts *must* be kept in stock.

Cleaning is an important item in keeping these devices functioning correctly. Weekly inspections are necessary to detect wear and provide replacement before failure occurs. The equipment, *except moving parts,* should be kept painted or covered with a chemical proof coating. The accuracy of proportioning devices should be checked at *least* daily. Under-feeding will cause insufficient coagulation or sterilization and over-feeding results in a waste of chemical.

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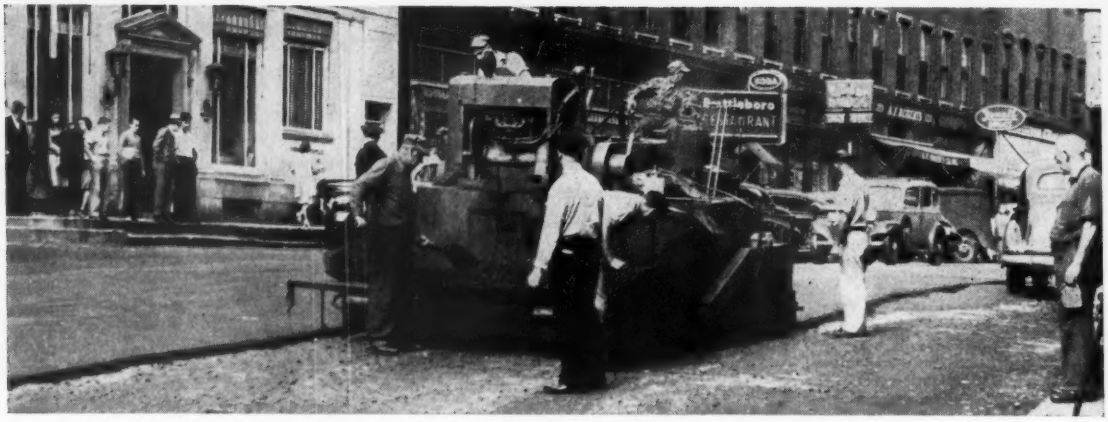


Resurfacing a main street in Brattleboro, Vt., without interruption of traffic.

Resurfacing With Hot Plant-Mix Bituminous Concrete

Methods and equipment used for widening and preparation for resurfacing a road. Procedure of laying a two course hot-mix bituminous pavement.

By F. C. COATES
Construction Engineer, Vermont Department of Highways

SOME Vermont roads which have been in use from 10 to 20 years are showing excess scaling and disintegration, and in order to salvage these pavements, the Highway Department decided to resurface them with a hot plant-mix bituminous concrete. For the first job a section was chosen on Route US-4, starting at the intersection of US-4 and US-5 at White River Junction and extending 7½ miles west to Quechee. This was an 18-foot road built in 1934, which showed bad scale and disintegration throughout its entire length. Sections had been resurfaced with bituminous material and pea stone seal, but this was not proving satisfactory on this particular section of road and a higher type of surface was desired.

Widening of Existing Pavement

As this reconstruction was financed in part by Federal Aid Funds, 2000 feet of 8-foot shoulders had to be built on one side in every mile of road, and the pavement widened from 18 feet to 20 feet. The widening operation was carried on first. A 4-foot wide trench was dug on each side of the concrete pavement to a depth 1 foot below the top of the concrete. This was excavated at first by either a ⅜-yard shovel or an angledozer, but later a grader with a trenching attachment was used which would excavate to a width of 3 feet and depth of 8 inches to 10 inches. The grader brought the excavated material onto the pavement and left it in a windrow, from which it was picked up by a bucket loader. This method was found to be much more satisfactory and cheaper.

The trench was then filled with bank run gravel. The gravel was dumped into the trench and spread by a power grader in two layers. Primary compaction was achieved by rolling with truck wheels. When necessary, the gravel was kept wet during this operation. Final compaction was made with a 3-wheel, 7-ton roller.

After completing the gravel shoulder, a trench was excavated next to the pavement in the newly built shoulder for the purpose of constructing a more permanent, stabilized foundation for the new bituminous concrete surface. The trench was excavated in the new gravel shoulder 18 inches wide and 3 inches deep. A power grader, which had a special drop blade bolted below the regular blade on the outside edge, was used for this operation. The attachment was 3 inches deep and 26 inches wide and the grader blade was set at an angle so that only an 18-inch wide cut was taken. Beyond the edge of the regular blade, a 2-foot arm was fastened to wing back the excavated material. This material was later pulled back against the new pavement.

This trench was filled with a lean mixture of bank run gravel, with RC-2 added at the rate of 14 gallons to the cubic yard. This material was processed through a Barber-Greene pug mill which proved very satisfactory. Later when it was tried to process this material through a hot-mix plant, it proved too expensive. It was also found very satisfactory, and cheap results were obtained, by using a shovel mix for the widening material. On this method a tar blend was used with a bank run gravel.

The shallow trench was filled with a bituminous mix from a spreader box attached to the rear of a truck. There was a sloping baffle on the inside of the box

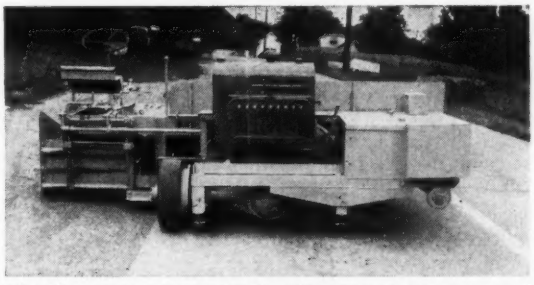
so the material could be pushed to the opening on the end which extended over the trench. A roller followed to compact the stabilized base course. A new machine has just been purchased for paving shoulders. This machine is self-propelling and trucks dump directly into the hopper. The machine pushes the truck in front of it until the truck is empty. There is a worm inside of the box which carries the mix to the edge of the pavement. The machine will pave from 1 foot to 6 feet wide and has a strike-off blade to give the desired depth.

The stabilized base was 18 inches wide, although the pavement width was only 1 foot on each side of the existing concrete. The additional 6 inches will tend to prevent ravelling at the edge of the surface course.

Paving Operations

In preparation for the resurfacing, all old bituminous patches on the concrete were scraped off and the expansion joints were cleaned to a depth of 1½ inches. A special tool was used for cutting out the joints, which consisted of a metal plow placed between two flat angle irons equipped with plow handles. The angle irons rode on the concrete and the device was pulled by a small rubber-tired tractor. These joints were then filled with a lean sand and RC-2 mix to about ½ inch from the top. The surface was swept clean and primed with MCO fog coat before the bituminous concrete was placed.

The hot-mix bituminous concrete was laid in two courses, a 1½-inch compacted base course and a 1-inch compacted top course, in two 10-foot lanes, by a tamping type finishing machine. The material was



Shoulders were paved with this All Purpose Spreader Co. road widener.

mixed at a State-owned asphalt plant, located 15 miles from the project at the source of aggregate, where a State-owned crushing plant processed the material for a Barber-Greene plant. Later the asphalt plant was moved to a location near the project and the crushing plant to another location. This was due to the Federal Government requiring the land where the plants were set up for a flood control project. Aggregate was bought from a near-by commercial crushing plant after the asphalt plant was set up in the new location. By this change it was proved that aggregate could be produced cheaper by a State-owned and operated crushing plant and with better assurance of proper grading and supply.

The bituminous concrete was spread with a Barber-Greene tamping-leveling-finishing machine, averaging 2000 feet full width base course 1½ inches thick per day. The average for the top course was 3000 feet per day, 1 inch thick. Both courses were laid in two ten-foot strips. This machine is built to pave 10 feet but, by blocking off or attaching extensions, it can be adjusted to cover from 8 feet to 12 feet in width.

In laying both courses, full width sections were completed each day. This was done so as to obtain a better bond on the center joint. The distance paved on the first strip, before setting back to pave the second strip, depended on the atmosphere and temperature. At the end of each strip, a ramp was built by placing a 1-inch manila rope across the pavement and rolling it into the pavement so as to make a square joint. When paving was continued on this strip, the ramp was dug up each time and paving was resumed at the square joint.

At first a 3-wheel power roller was used for rolling, but this was replaced by a tandem roller with much better results being obtained. The rolling was done longitudinally from the outside edge of the pavement toward the center and followed to within 50 feet or 100 feet of the paver. When the second lane was being laid, the center joint was rolled immediately to assure a better bond. Traffic was allowed to use the pavement as soon as rolling was completed.

The crew required to carry on the paving operation consisted of a foreman, paver operator, roller man, two men to operate the jacks on the rear of the paver, two men at the receiving end of the paver, and two flag men. The flag men were equipped with two large signs to warn traffic. These signs were mounted on skids and were pulled along the pavement by the flag men as work progressed. The above crew took care of raking, building of ramps, and lining of the edges of the new pavement when necessary.

Most of the trucks used carried 4 yards and were equipped with tarpaulins to cover the load. The metal bodies of the trucks were sprayed with light oil at the plant before each load to prevent the hot-mix from sticking to the bodies.

The Hot-Mix Plant

The aggregate was stockpiled near the plant in three piles: bottom course aggregate, top course aggregate, and sand. Aggregate was placed in the plant hopper by a crane with a clam shell attachment. From the hopper, the material moved up a bucket elevator to a single drum drier, 18 feet long and 4 feet in diameter, which was heated by a Hauck burner consuming about 500 gallons of fuel oil per day. The fuel oil was stored in an 8,000-gallon tank and pumped to the burner.

The steam required to vaporize the oil was furnished by a 50 h.p. coal-fired boiler carrying 110 pounds of steam pressure. A new oil burner has been purchased so as to use fuel oil instead of coal. This eliminates a fireman, and the fuel will come from the same storage tank as that for the drier.

An enclosed bucket elevator moved the hot aggre-

Central plant set-up for producing hot-mix bituminous concrete.

gate from the drier to the classifier. A dust collector was added to the plant after the first season. This collector takes all the material discharged through the stack of the drier and settles out most of the fines which are discharged into the hot elevator by means of a worm shaft.

On the classifier there is an inclosed shaker screen which classifies the aggregate. There are three screens in which the sizes of the openings vary in accordance with the type of mix desired. From the screens, the aggregate goes into three separate bins. The first bin is for sand and holds 8 cubic yards. The second bin is for intermediate stone and has a capacity of 10 cubic yards. The third bin is for coarse stone and holds 6 cubic yards. The aggregate passes in a constant stream from the bins to the pug mill, being measured as it goes by reciprocating feeder gates.

The pug mill is of a continuous type giving a constant flow of finished material. The aggregate, as it enters the pug mill, is sprayed with 80 to 100 penetration asphalt. Directly over the pug mill is a lime feed which discharges lime into the mix. The pug mill is equipped with a 500-gallon asphalt storage tank, and this is fed by an asphalt distributor which hauls directly from the tank cars. The asphalt is heated to 340 degrees Fahrenheit. The finished mix leaves the plant at from 300 to 310 degrees.

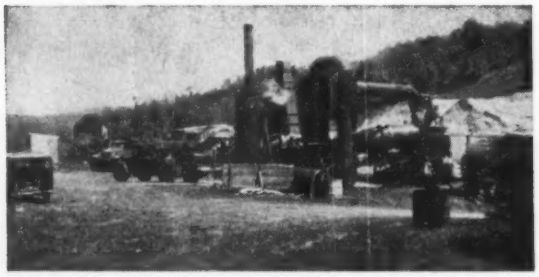
A location for the plant is always given careful consideration in order to have it as near the center of projects as possible, near a source of water, and remote from any town or village due to soot and dust that is blown from the plant. The plant is moved from one location to another very economically. The pug mill, classifier and drier are all mounted on rubber and can be towed over the road by truck. When the plant is set up, the tires are removed and each unit is set on blocking.

The personnel at the plant consists of a plant foreman, pug mill operator, crane operator, two greasers, one man to feed the lime hopper, two rakers to level the loads, and a night watchman. In addition to the personnel at the paver and plant there is one general superintendent and timekeeper, who also keeps a cost record of all work.

A typical gradation of the mix for base and top courses is as follows:

Square Openings		Per Cent by Weight	
Passing	*Retained*	*Base*	*Top*
¾ in.	½ in.	25-30	0
½ in.	⅜ in.	18-22	15
⅜ in.	No. 4	8	20
No. 4	No. 10	7	15
No. 10	No. 40	17	21
No. 40	No. 80	9	12
No. 80	No. 200	5	5
No. 200		5	6
Asphalt (penetration 85-100)		5	6

The mineral filler, a domestic ground limestone, 85% of which passes a 200 mesh sieve, is supplied in paper sacks. It was found necessary to add a filler to the mix due to the lack of fines in the aggregate. However, since the dust collector was added to the plant, the quantity of lime has been reduced about 50%. Ground limestone was chosen for a filler due to its availability and low cost. This material was delivered direct from the mill to the plant by truck.



Another view of the central plant showing the aggregate drier.

Construction Completed and Prepared

After the first section of 7½ miles was completed, the Highway Department looked with great favor on this type of resurfacing for old concrete. An additional five miles was widened and paved on Route US-4 just west of the first project. A mile was widened and paved on Route US-5 just east of the first project. In all, 16 miles of bituminous concrete resurface has been laid on old concrete pavement in the White River Junction area.

Excavating shoulder prior to filling with gravel.

In addition to this, the towns of Hartford, Woodstock and Brattleboro have had sections of their main streets paved with bituminous concrete from this plant, except Brattleboro, where the bituminous mix was bought from a commercial plant, but the paving was done by the State crew and State finishing machine.

Five bridge floors were paved using the finishing machine and top course (or finish surface mix). A depth of 1½ inches was used on all but one floor. This particular bridge has a grid floor filled with concrete and a one-inch bituminous paving was used.

A four-mile experimental project on Route US-5, north of Norwich Village, was built this past summer using six different combinations of mixes and depths. This road originally was constructed in 1936-1937 with a gravel base and a 22-foot double tack coat of refined tar surface. The six experimental sections were constructed 22 feet wide and directly on top of the double tack coat.

The first section was built in two courses: the base course was constructed of 2½ inches of crushed washed gravel ranging in size and uniformly graded from ½ inch to 1½ inches, mixed with 9/10 of a gallon of tar blend per square yard. The blend consisted of 50% of RT-5 and 50% of RT-8. The base course was mixed-in-place by a power grader and rolled and filled with pea stone. The second course consisted of a 1-inch hot-mix top. The grading of this course was the same as used on the top course resurfacing for concrete pavement.

The second section was a 2-inch hot plant-mix with the maximum size of aggregate being 1½ inches. This was paved with a 1-inch top as in section 1. The third section was a 3-inch hot plant-mix with a maximum

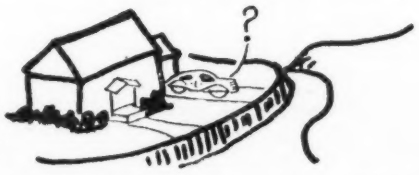
(Continued on page 42)

LEGAL DECISIONS
Regarding Streets and Highways

By JOHN SIMPSON
Attorney

Interesting points concerning street excavations, lowered highway grades and drainage depressions at intersections.

High and Dry



Lowering Highway Grades.—In an action against a county in Kentucky for injuries to land abutting a highway which resulted from the State Highway Commission's lowering the grade of the highway, impeding the owner's ingress and egress, the Kentucky Court of Appeals [Bader v. Jefferson County, 274 Ky. 486, 119 S. W. 2d 870], said the question in the case was whether a county must compensate a landowner for such injury from lowering of the grade where it is done without taking any of the land or causing other resulting injury. The court answered this question in the negative. Its decision rested upon its interpretation of the state statute providing that the county should bear "all cost of acquiring any necessary land or right of way and any damages incurred, awarded or paid." In the phrase "damages incurred," the court said, the Legislature undoubtedly meant damages incident to the acquisition of a right of way in the exercise of the power of eminent domain. It has often stated that rights of action for compensation subsequent to the taking of property rest upon the same basis as if the proceeding had preceded the taking. So far as shown the county did nothing whatever in this road construction. There was no right of way "acquired" at this point. The county was not called upon to furnish a right of way. Judgment for the defendant was affirmed.

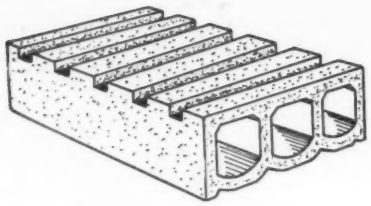
"Thank-You Marm"

Drainage Depressions at Street Intersection.—In an action for injuries to the occupant of an automobile while crossing two gutter depressions at a street intersection which jolted the plaintiff out of the rear seat of the car the city's defense was that the improvement of the street had been made in accordance with plans and specifications made by a skilled and competent engineer who supervised the work, that the adoption by the city of such plans and specifications was a governmental function, and the city was not liable for injuries resulting therefrom. The Iowa Supreme Court [Dodds v. Town of West Liberty, 281 N. W. 476], sustained this defense and affirmed judgment for the city on a directed verdict. The court applied the rule that a municipal corporation is not liable for injuries to a person resulting from the adoption of an improper plan due to error of judgment on the part of its engineer unless the plan adopted was obviously so hazardous that it must be so considered as a matter of law. There was competent engineering evidence tending to show, and the court held, that the crossing was reasonably safe for automobile traffic traveling within the speed limit; and the town council could not be held liable because the town's engineer did not adopt the best plans.

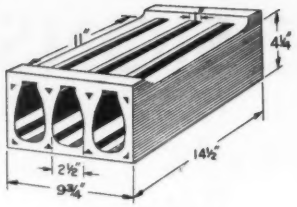
The Case of the Open Trench

Insufficiently Filled Street Excavation.—The Massachusetts Supreme Judicial Court [Sloper v. City of Quincy, 16 N. E. 2d. 14], holds that, apart from statute, a municipality is not liable for negligence in the conduct of strictly public functions from the performance of which it receives no profit or advantage because this "would involve the municipality in endless embarrassments and difficulties which would be subversive of public interests." On the other hand, a city or town is liable for negligence in the conduct of commercial enterprises voluntarily undertaken for profit or to benefit its corporate interests, although a public need is ultimately subserved. It holds that a system of water supply in part for the use of inhabitants who pay for the water thus supplied constitutes a commercial venture, and that a city or town is liable for negligence in connection therewith just as a private corporation would be liable in performing a similar service.

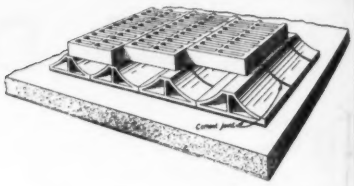
The liability of a city for damages to an automobilist from driving a car over an imperfectly filled pit dug by its water department to repair a broken main, part of the city's water system, would not, it was held, arise from the city's failure to keep the street in proper repair, but upon its act in digging a pit and leaving it insufficiently or improperly filled and unguarded, in the course of conduct of its commercial venture in maintaining its water system. The state statute requiring notice of the time, place and cause of injury would not apply.



Cannelton "Translot" block.



Natco Unifilter tile.



Metro two-unit filter floor system.

TRICKLING FILTERS

This article, the second of a series, discusses important factors of underdrainage and ventilation and structural details of walls, floor and channels.

THERE are certain details of design that are common to all filters and may be considered before the various types of trickling filters are discussed. Of primary importance are the underdrainage and ventilation system, for these may determine whether or not the filter will operate efficiently. The floor of the filter, the drainage channel, and the wall structure are also elements that must be considered irrespective of the particular type of filter that is utilized. In this installment, these details of design will be discussed. The next installment will consider standard or low rate filters.

The Filter Floor

The floor of the filter must support the underdrainage system and the superimposed load of the filter media; and in filters designed to be flooded, the water load also. It must be constructed of a material that will surely retain its uniformity of surface and slope indefinitely. Earth or gravel, no matter how well compacted, is unsatisfactory. A concrete floor, about 6 ins. thick, is standard. Reinforcement may consist of ½ in. bars 12 ins. on centers or bar mat or fabric, about 5 lbs. per sq. ft., placed in the middle of the concrete section. Though the unit loading is not heavy, the subgrade should be adequately prepared, and compacted if necessary, to prevent any settlement whatever. Some engineers prefer to pour the floor in a single run, but there is no objection to joints. These should run in the same direction as the slope; reinforcement or dowels should be carried through the joints; and if there is any question of the stability of the subgrade, footings should be placed under the joints.

Floor Slope

The floor should generally be sloped to a central drainage channel along one diameter. Some designs slope the entire floor to one outlet. This arrangement requires special provision at the distributor support to prevent a dead space there and also creates complications at the entire outlet half of the filter; and it may interfere with ventilation. In some installations, the slope is from the center of the filter to a peripheral channel which may be outside the filter. Floor slope should be about 0.3 ft. per 100 ft., but a fall of not less than 2 ins. should be provided for the semi-diameter of any filter.

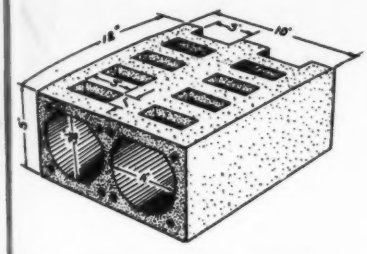
Underdrainage and Ventilation

Definite provision must be made at the bottom of the filter for prompt removal of the sewage as it percolates through the filter; and also for an adequate flow of air into and from the filter. Because this underdrainage and ventilation system is essential to the operation of the filter, and because it is costly or impossible to inspect, repair or replace, the best of materials should be used, and the greatest care taken in construction to insure that it is properly and effectively placed.

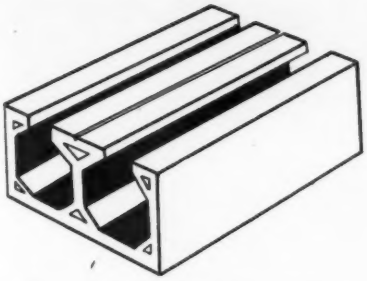
It is not necessary to provide two systems of conduits, one for the liquid and one for ventilation. The same system can be used for both, the liquid occupying the lower part of ducts and the air the upper part. The important thing is to provide facilities which will not clog under long use, will not deteriorate under the action of the sewage, and will distribute the air uniformly to all parts of the filter.

The tentative standards of the upper Mississippi Basin Group[2] requires, for high rate filters, that the filter underdrainage system (1) should be of such capacity that when carrying maximum discharge, the flow will not occupy more than one-third of the vertical cross-sectional area; and (2) should have a total unsubmerged outlet area—that is drainage openings—equal to at least 5% of that of the filter surface. This latter requirement excludes the use of half-tile, with which it is practically impossible to obtain unsubmerged outlet openings of 7.2 sq. ins. per sq. ft. The standard is probably low; in the absence of precise data, operating results in certain existing installations indicate that it may be advantageous to use underdrainage having openings of at least 20% of the floor area, or 28.8 sq. ins. per sq. ft.

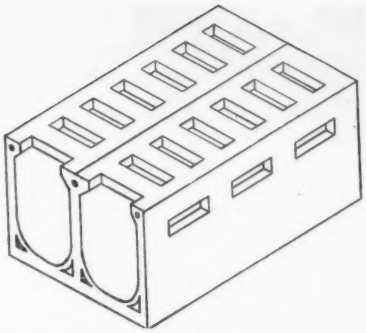
When the floor of the filter slopes to a central drainage channel, the underdrains are best laid in parallel lines at right angles to the central channel, extending from it to the outer wall. If desired, openings in the wall can be provided to improve ventilation and permit access for inspection and cleaning although this prevents flooding the filter for fly control. Complete conduit systems, ready made to lay directly on the floor of the filter are available. These units, which are described below, are of vitrified clay, in the form of a quadrangular prism, each having ample duct capacity and openings in the upper face. These blocks are laid on a thin layer of grout, on a very thin bedding course of sand, or directly on the floor of the filter. Installation is simple and rapid, the danger of improper construction is eliminated, and unskilled labor can be used. The blocks cover the entire floor of the filter, forming continuous underdrain channels having the same



12" Armcre block made by Bowerston.



Mono-unit type Metro filter floor system.



Armcre "AA" block with lateral ventilation ducts.

By the Editors of Public Works Magazine and Consultant Staff

R. S. Rankin, B. A. Poole, F. H. Waring, H. M. Bosch, L. L. Langford, C. W. Klassen, Ray E. Lawrence, S. L. Tolman and J. J. Gilbert

slope as the floor on which they are laid, and providing a continuous support for the filter media over the entire floor area.

The "Armcre" filter bottom block is made by the Ayer-McCarel-Reagan Clay Co. and the Bowerston Shale Co. As made by Ayer-McCarel-Reagan, this block is 16" long, 10" wide and 5" high; as made by Bowerston Shale Co., it is 12" long. Lengthwise through it run two ducts, approximately circular in section and 4" high, with an area of 12.5 sq. in. each. This gives a combined conduit area of 30 sq. ins. per foot of width, each block has apertures in the top, each about 3" by 1" with a total opening of approximately 30% of the total area. The Ayer-McCarel-Reagan blocks weigh 26 pounds each or about 24 pounds per sq. ft. and the Bowerston blocks about 21 lbs. These companies also make a deeper type block which will be described later.

The Cannelton "Translot" filter bed block is 11¾" wide by 18" long and 4¼" high. Each block contains 3 ducts each approximately 3" high and 3⅛" wide, with segmental bottom and vertical sides. These provide about 24 sq. ins. of area per foot of width. Across the top are five channels, each about 1" wide, and extending down to the tops of the ducts. These provide a total top area opening of about 45 sq. in., equal to 30 sq. in. per sq. ft., or 21% of the top area. The blocks weigh about 32 pounds each.

The Metropolitan Paving Brick Co. makes the "Mono-unit" block, which is 10" wide, 12" long and 5" high. It has two octagonal channels, 4" wide by 3½" high, giving a total conduct area of about 23 sq. ins. equivalent to 27 sq. ins. per foot of width. A continuous slot in the top over each duct, which is 1½" wide, gives a total area of top opening equivalent to 30% of the top area, or 43 sq. in. per sq. ft. This company also makes a 2-unit block described below.

The National Fireproofing Corp. makes the "Natco Unifilter" block. This is 14½" long, 9¾" wide and 5" high. It has three egg-shaped ducts, each 2½" wide at the widest part and about 3½" high, giving a total duct area of 22 sq. in., equal to about 26" sq. in. per foot of width. There is a continuous slot 1" wide at the top of each duct for 11" of its length, giving a top opening of 33 sq. ins. for the block, which is just one square foot in area. At each end of the block, the top is reinforced with a strip 1¾" wide and about an inch thick, integral with the remainder of the block.

The Metropolitan two-unit block is called the "Metro." It consists of the channel block, which forms, when assembled on the filter floor, a series of parallel channels; and the grill blocks which bridge these channels and support the filter stone. The channels so formed have rounded bottoms, which are 11" wide at the top, and 3" deep, with flat surfaces 2½" wide between them to serve as supports for the grill blocks. The area of each channel is about 30 sq. ins., equivalent to about 26 sq. ins. per foot of width. Each grill block is 13 7/16" by 6¾" by 3" deep and contains six slots, with a total surface opening area of 36 sq. ins. or 40% of the area.

The Armcre "AA" block has larger ducts and more ventilation openings. There are two channels, each 4" wide by 6" deep, giving a cross-sectional area per duct of 24 sq. ins. and per ft.

Courtesy Ayer-McCarel-Regan Clay Co.

Laying underdrains for a filter. Blocks are placed in a thin layer of grout.

Courtesy National Fireproofing Co.

Placing stone in trickling filter by means of a conveyor.

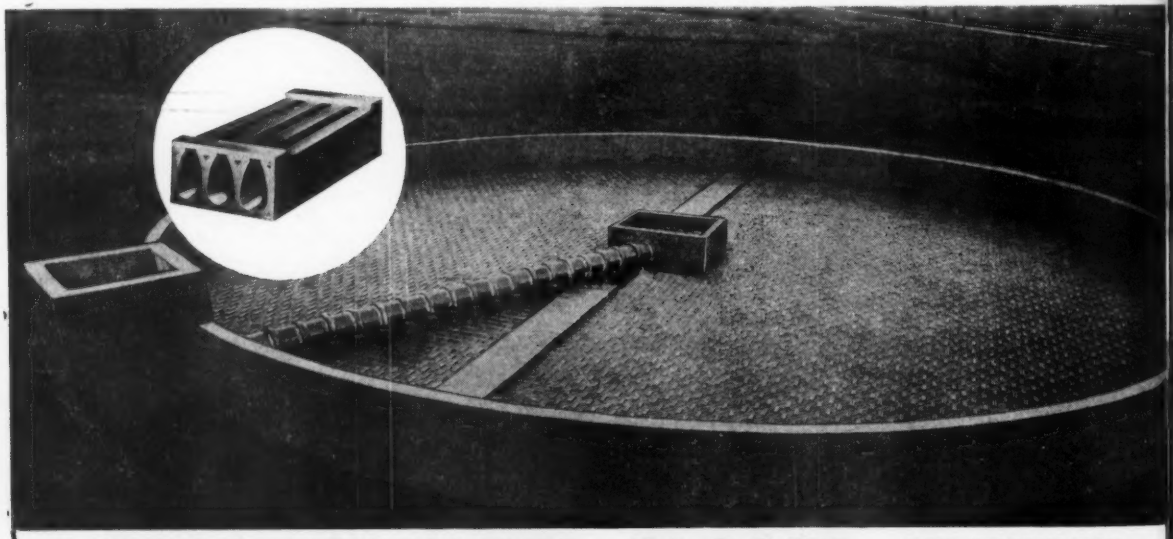
of about 57 sq. ins. In addition to 14 top apertures each 3" by 1", it has six side openings of the same size, permitting horizontal ventilation. This block is 16" long, 10" wide and 7½" high, and weighs 30 pounds per block or 234 pounds per sq. yd.

All of these underdrains meet and exceed the requirements of the Upper Mississippi Basin group and comply with ASTM specifications for filter bottom blocks. The ventilation and drainage openings on the upper face exceed 20% of the filter area in all cases. Assuming a filter 150 ft. in diameter dosed at the rate of 30 mgad, the flow for the maximum 1-ft. wide strip would be 0.08 cfs.; and at 2 ft./sec. velocity the channel area required would be 0.04 sq. ft. or about 5¾ sq. ins., which is considerably less than one-third of the area available in any of them.

All of these blocks have excess strength to carry the load due to the filter stone above. The average resistance to crushing is about 600 pounds per sq. in., or 90,000 lbs. per sq. ft.; the load that may reasonably be expected to be placed on them will not exceed 1000 lbs. per sq. ft. Most or all of these blocks can be furnished with standard mitered ends and in shorter lengths to facilitate fitting into the filter. With blocks of this type it is not necessary to use upright vents at the end of each line of blocks as adequate ventilation is provided otherwise. However, blocks can be provided to permit this, and air duct cover blocks are available to facilitate circulation around the periphery of the filter.

Drainage Channels

The function of the drainage channel is to receive the flow from the underdrains and convey it to a discharge pipe, and to bring to the underdrains the air necessary for ventilation. The channel preferably should be straight and accessible for inspection and flushing or cleaning. Location is generally along one diameter of the filter, or slightly offset from it, with the floors of the two halves sloping to it. This arrangement is generally preferable to any other and requires very little more head, if any. On shallow filters, the feed pipe is usually brought underneath the floor and up through the distributor support. A central well may then be used, and the channel curved around it, or the channel offset to clear the support. On deep filters, the feed pipe is frequently carried about 2 ft. under the surface of the stone. In cold climates, there may be danger of freezing if the well construction is used. The drainage



NATCO UNIFILTER BLOCKS **FOR TRICKLING FILTER BEDS**

Above is one of two tanks, 90 ft. in diameter, installed at the LaChoy Food Products Division of Beatrice Creamery at Archbold, Ohio. Here Natco Unifilter Blocks of glazed, hard-burned clay, by reason of their light weight and single unit feature were rapidly and economically installed. Their great structural strength has resulted in low repair and maintenance costs. Write for literature.

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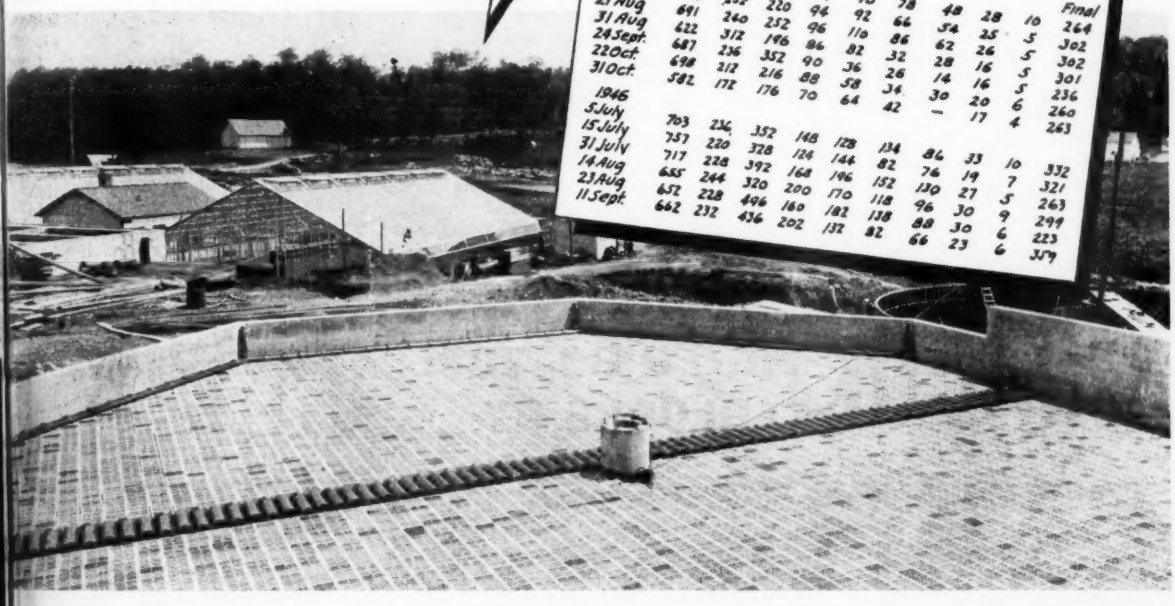
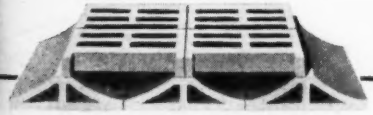
It's Results that Count!

Study this performance record of the METRO TWO-UNIT FLOOR in the Bio-Filtration Sewage Treatment Plant at Liberty, N. Y.

Summary of Operating Results at the Liberty Plant, 1945-1946

Date.	Flow MGD	Raw Sew.	Pri. Inf.	Pri. Clar. Eff.	Filters → Pri. Eff.	Filters → Sec. Inf.	Sec. Clar. Eff.	Sec. Clar. Eff.	Final Eff.	DO Final
1945	BOD-Composite, 8AM to 1PM									
14 June	0.87	270	110	153	108	60	22	—	—	5.8
11 July	0.92	380	280	207	100	80	40	23	8	5.0
21 Aug.	1.05	320	220	190	120	90	46	20	5	4.2
31 Aug.	0.92	380	170	120	68	45	35	27	4	5.0
24 Sept.	0.90	380	280	147	57	49	30	21	3	5.6
22 Oct.	0.74	380	200	120	60	50	33	24	6	6.4
31 Oct.	0.73	300	180	120	73	48	—	24	14	5.0
Average		344	206	151	83	60	34	23	6.7	
1946										
5 July	0.82	300	300	173	134	140	60	37	17	—
15 July	0.81	420	420	220	133	80	48	21	6	4.4
31 July	0.96	440	300	210	140	100	80	29	6	3.6
14 Aug.	1.05	360	480	220	160	145	49	32	10	3.8
23 Aug.	0.95	340	380	250	153	95	42	21	8	3.8
11 Sept.	0.77	360	300	193	120	80	45	24	6	5.8
Average		367	362	211	137	107	54	27	9	
1945	TS Raw	Suspended Solids								TS Final
14 June	547	160	240	94	70	78	48	28	10	264
11 July	814	352	220	94	92	66	54	25	5	302
21 Aug	691	240	252	96	110	86	62	26	5	302
31 Aug	622	312	196	86	82	32	28	16	5	301
24 Sept.	687	236	352	90	36	26	14	16	5	236
22 Oct.	698	212	216	88	58	34	30	20	6	260
31 Oct.	582	172	176	70	64	42	—	17	4	263
1946										
5 July	703	234	352	148	128	134	86	33	10	332
15 July	757	220	328	124	144	82	76	19	7	321
31 July	717	228	392	168	196	152	130	27	5	263
14 Aug	655	244	320	200	170	118	96	30	9	299
23 Aug	652	228	496	160	182	138	88	30	6	223
11 Sept.	662	232	436	202	132	82	66	23	6	349





METRO TWO-UNIT FILTER FLOOR

- ★ Superior performance proved by many installations since 1926.
- ★ Area of channels is 64% of cross sectional filter area.
- ★ Area of apertures is 40% of filter floor surface.
- ★ High grade de-aired clay, vitrified, impervious to chemicals.
- ★ Adaptable to circular, rectangular or octagonal floor design.

● The above operating summary from the office of W. A. Hardenbergh, consulting engineer, New York, shows why Metro vitrified floor systems for trickling filters are preferred by sanitary engineers, and health officials.

Mr. Hardenbergh says: "... since its installation late in 1940, results have been uniformly excellent".

Write for complete information on engineering service and products.

Metro

PRODUCERS OF QUALITY CLAY PRODUCTS SINCE 1902

THE METROPOLITAN PAVING BRICK COMPANY

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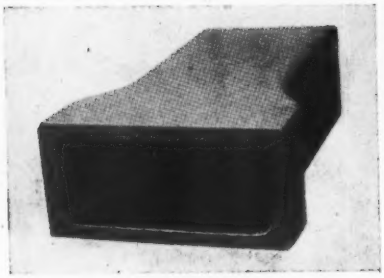
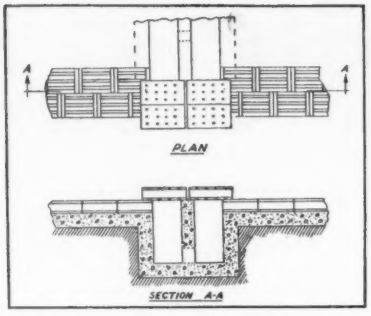


Reducer extension for continuing underdrain through filter wall.



Extra wide effluent channel with lengthwise supporting wall.

Cover block with vent pipe opening.

channel may be passed through the distributor support, carried around it, or offset past it. Collecting channels may be placed in tunnels, constructed either on the diameter of a circular filter, or partially around its periphery; and such tunnels, if used, permit inspection of underdrains.

There are few precise data on which to determine the desirable size of the drainage channel. For low-rate filters, where there is no possibility of later use of recirculation, the channel can be relatively small—12″ wide and 8″ deep for a 100-ft. diameter filter. With high capacity filters, with high surface application rates and also high ventilation requirements, the channel must be made very large. At a rate of 30 mgad., the discharge from a 100-ft. diameter filter would be 8.7 cfs.; and the air requirements might amount to 130 cfs. The 80-ft. biofilters at Liberty, N. Y., have channels 24″ wide, with a capacity in excess of 6.2 cfs. These have been adequate for both drainage and ventilation, as indicated by the remarkable results obtained from this installation ever since it was put into operation. J. J. Gilbert recommends a design to provide a velocity of 2′ to 3′ per second, with high water level at the bottom of the underdrain blocks. R. S. Rankin prefers 6″ freeboard between the water surface in the channel and the invert of the laterals draining into it. Where the filter is to be flooded, slip gates placed a little lower than the top of the filter wall, should be provided in the design.

Channel Covers

The center channel must be covered, and the cover must serve as an underdrain and ventilator for the portion of the filter above it. On small installations, filter blocks or grill blocks, similar to those used in the Metro two-unit underdrain, can be used. These blocks, 3″ deep and 11″ between supports, have been tested to 5570 to 13,300 lbs. per sq. ft. Natco has a specially designed cover block which is essentially their underdrain block inverted and with the upper surface perforated to provide drainage. This block is made in lengths of 14½″, 18″, 24″, 30″, 36″ and 42″; 5″ deep; and with perforations every 3″ to 6″ apart. Armcre cover blocks are also made either solid or perforated in

ARMCRE FILTER BOTTOM BLOCKS BY BOSCO

For Better Trickling Filter Operation

Trade Mark Reg. U. S. Pat. Office

Proved by performance in hundreds of sewage disposal plants, ARMCRE Filter Bottom Blocks meet all requirements for completely successful underdrain construction.

Special Features:

One of the easiest blocks to lay.

Made of highest quality de-aired Vitrified Shale and Fire Clay.

High compressive strength.

High resistance to acid or chemical action and deterioration.

Exceptional aeration and drainage features.

Easy to work over after laying.

More than 26% of top of each block is used for rectangular openings, permitting air to circulate freely and maintain ideal aerobic conditions. Entire inner surface of ducts is smooth. No solids accumulate in an ARMCRE system.

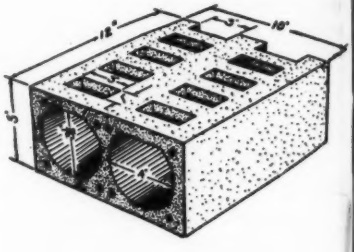
App. Dimensions and Weights

Full Block: 12″ long, 10″ wide, 5″ high.

Ducts: Each 4″ wide by 3½″ high; Cross-sectional area per duct, 12.5 sq. in.

Top Openings: each 3″ long by 1″ wide.

Weight per Block: 20 pounds. Weight per square yard of floor: approx. 240.



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BOSCO Plain End Pipe and Tru-Line Collars
(Plain and Perforated Pipe)

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Drainage Material Specialists

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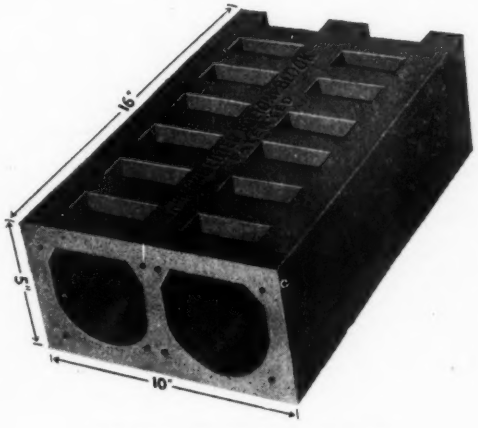
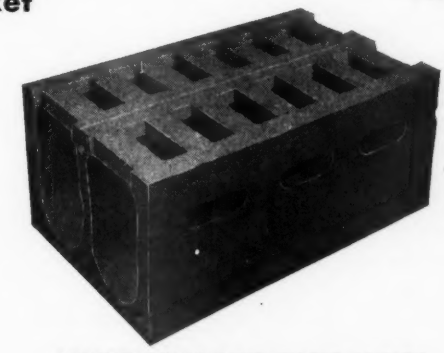
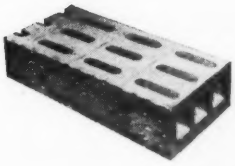


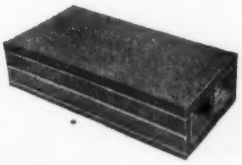
ARMCRE STANDARD BLOCK
5 x 10 x 16



ARMCRE HIGH RATE FILTER BLOCK
7½ x 10 x 16

For use in high rate filters assuring sufficient drainage, aeration and cross ventilation.

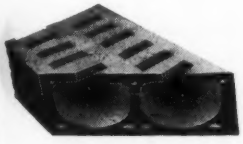




COVER PLATES

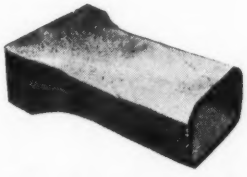
4 x 8 x 16 to 4 x 8 x 30 perforated cover plates for covering drainage channels.

4 x 8 x 16 to 4 x 8 x 30 cover plates for covering drainage channels.



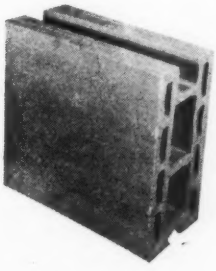
ANGLE CUTS

Angle cuts for use around the periphery of the bed assuring maximum drainage and aeration.

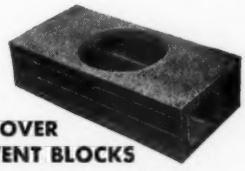


REDUCER & REDUCER EXTENSION

Reducer and reducer extension for passing through walls to drainage channels.



TANK BLOCKS →
6 x 12 x 12 tank blocks for outside walls of trickling filters.



COVER VENT BLOCKS

4 x 8 x 16 to 4 x 8 x 30 cover vent blocks with openings to accept 4" or 6" vent pipe.

SPECIAL FEATURES

All ARMCRE blocks are made from fire clay, vitrified and salt glazed. It is a one-piece unit.

•

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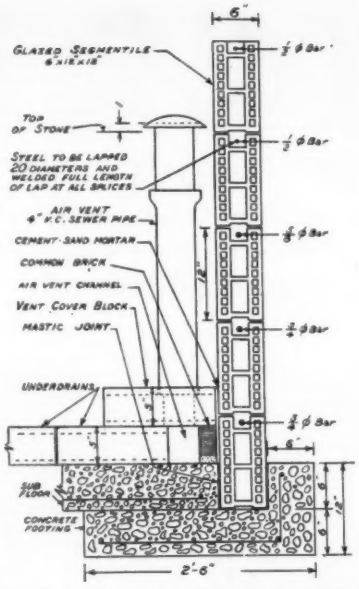
sizes from 4" x 8" x 12" to 4" x 8" x 30". Where excessive channel widths are necessary the channel cover span may be cut in half by building a center wall. Perforated half-tile 6" or 8" in diameter, may be laid across the channel. A half tile preferably perforated, having the same diameter as the channel can be laid longitudinally, providing additional air space over the channel. On shallow filters, this appears undesirable, and the other devices mentioned are preferable.

Shape of Filters

Most filter units now being built are circular in shape because rotary distributors are commonly used. When fixed nozzles are utilized, beds are normally rectangular in shape. The various distributing devices will be described under each type of filter.

Walls for Filters

While some early filters were built without walls, common practice is to use a wall to contain the filter material. Walls may be either tight or open. Tight walls permit the filter to be flooded for the control of filter flies, but some engineers feel this construction may interfere with ventilation; and the development of control methods for filter flies by means of chemicals, as DDT or chlorine, largely obviates the necessity for tight walls for this purpose. In cold areas, tight walls are desirable to prevent undue lowering of the temperature of the body of the filters.



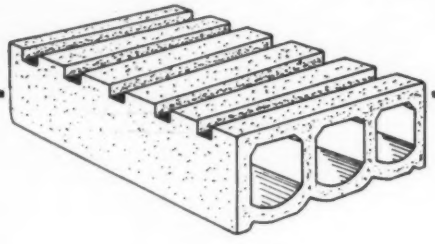
Details of underdrain venting system and filter wall constructed of tile block.

Walls may be of any appropriate material, as concrete, tile or stone. The walls of a circular filter may be designed to resist stresses as a cylinder, while a straight wall is designed as a retaining wall.

When concrete is used, a good mix should be specified, with carefully controlled water-cement ratio. From 6 to 7 gals. of water per bag of cement, including the water present in the aggregates is sufficient. The use of a good admixture, such as pozzolith, is very helpful in producing a smooth, tight wall, and eliminating or greatly reducing honeycombing. Enough cement may often be saved to pay for the admixture, and the cost of skilled labor required for finishing the wall and repairing honeycomb is largely avoided. Forms for concrete walls should be tight, smooth and clean; plywood, tongue and groove lumber or metal should be used.

Vitrified segment tile blocks, or even vitrified structural hollow tile may be used for walls. Segment or radial hollow tile is 6" or 8" thick, curved to any radius up to about 60 ft., and provided with recesses for reinforcing rods and with bonding at both horizontal and vertical joints. In addition to its use as a wall, this tile may be used for a decorative facing or an insulating layer, or both. For insulation, it may be used inside or outside of the wall. When used as a containing wall, such blocks should be anchored firmly to and inset slightly into the base. The structural blocks may be laid with the openings running through the wall. The horizon-

(Continued on page 68)



TRANSLOT

The Efficient Filter Block with the Transverse Slot

TRANSLOT blocks are made from Vitrified Clay, the EVERLASTING and ACID PROOF material. Its Salt Glazed, smooth walls permit the rapid flow of sewage.

Transverse Slots across the top of the block provide properly proportioned openings into the ducts for collecting downward flow of liquids and the upward passage of AIR.

Lengthwise grooves on under side of each block hold alignment when laying. Uniform in size, 6 blocks cover a square yard of filter floor. Self aligning and self spacing, they are easily and rapidly laid on 1 foot centers. Translot, made with standard fittings, can be used on all types and designs of Trickling Filter Beds.

TRANSLOT ADVANTAGES Include:

1. One piece—easy to lay.
2. Made from vitrified clay and salt glazed.
3. 12" wide and 18" long—easy to figure.
4. Cross Ventilation betwen ducts made possible by transverse slots.
5. Furnished with all shapes—Manufactured to your plans.
6. Properly proportioned apertures provide thorough ventilation and rapid run off.
7. Close dimensional tolerances and carefully inspected.
8. High in compressive strength—Low in absorption.

Send your plans and let us submit estimates of quantities and prices.

Cannelton Sewer Pipe Co. CANNELTON, INDIANA

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Pump Equipment

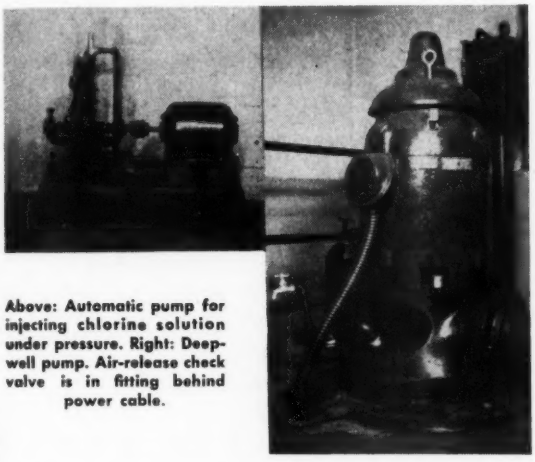
(Continued from page 20)

On removing the cap and opening up the air relief to free discharge, this trouble entirely disappeared.

It is desirable that a vent be provided in the well, between the well casing and the pump column, although usually the pump base casting has this built in. This vent should terminate in a small inverted U-tube made up of standard fittings and with a screen on the end to prevent insects from entering.

The piping from the pump discharge, including the check and gate valve, can be either flanged or bell and spigot, although it is generally advisable to have flanged fittings on the portion of piping that may require removal when dismantling or repairing the pump. Often close quarters in the pump house may be the deciding factor.

Operating records are important, and the quantity



Above: Automatic pump for injecting chlorine solution under pressure. Right: Deep-well pump. Air-release check valve is in fitting behind power cable.

of water being pumped should be known. The water may be measured by the use of a venturi tube, an orifice or a meter, or by other means. In recording this flow, both the total quantity pumped and the rate it is being pumped are important. Such data should be automatically recorded and if the pump is located away from the main station, the flow recorder can be placed in the main station where it is under the operator's constant observation.

This may be done by a private line from the pump house or by the means of a leased telephone circuit. An instantaneous record of what is being pumped gives the operator at the main station a complete check of whether "all's well" or not, and if a sudden change occurs he can immediately go to the remote pump station and find out what is wrong. In place of automatic controls, the remote station may be manually controlled over private or leased telephone lines.

Chlorination is generally required of potable water supplies, and equipment can be provided for complete automatic operation. When pumping into the distribution system, it is generally necessary to have a small auxiliary pump to supply the chlorinator with water at a higher pressure than the system pressure, in order properly to inject the chlorinated water in the line. This pump and chlorinator can be hooked up with the automatic controls so that these operate only when the pump runs. By time delays the chlorinator can be started up a minute before the main pump starts.

Generally, pumps are equipped with automatic oiling devices that provide for pre-lubrication on starting. These are operated by electric solenoid valves and it is desirable to specify that such lubrication be provided.

In assembling the various parts of the pump and chlorinator, it is necessary to see that all parts in contact with the water are cleaned of dirt and grease, that parts are dusted with HTH or other sterilizing powders, and that the pump is completely sterilized before being put into use.

Water Plant Maintenance

(Continued from page 25)

Due to the danger from chlorine gas, there is no equipment in a water treatment plant that requires more careful attention than the chlorinator. All pipe, connections, valves and the machine itself *must* be checked at least once *each watch* for leaks, and periodically for corrosion. All exposed metal parts should be kept painted or greased. The chlorine solution hose or pipe is very susceptible to corrosion and should be replaced at the first sign of deterioration. Use of differential converters for automatically controlling chlorinators requires weekly inspection for accuracy and cleaning of the apparatus. The ventilating system is an important item in chlorine equipment installations. Weekly test operation of the fan is desirable to assure readiness for instant service when needed.

Contrary to the recommendation of scale manufacturers, it is advisable to keep all metal parts, especially the knife edges and pivots, of scales used for chlorine cylinders or containers coated with a soft grease. Metallic parts of chlorinators that have become corroded by chlorine may be cleaned by soaking in a 25 percent solution of caustic soda, followed by a water rinse and hot air drying. The chlorides on corroded metal absorb water from the atmosphere causing acceleration of the reaction and rapid failure of the part. A clean chlorinator is a safe chlorinator.

Standby Equipment

Caution must be taken to prevent damage to equipment which is out of service for any length of time. When stored for long periods, special protective covering or greasing will be necessary to prevent rusting or other damage.

Filters, Gauges and Meters

It has been noted over many years, that with perforated metallic pipe or similar strainer systems, many very small sand particles become mechanically wedged in the openings. This retards the equal distribution of wash water and reduces the filtered water collection area. Removal of these grains may only be accomplished by removal of the sand and gravel to permit manual cleaning.

With the use of pre-chlorination in super-chlorination concentrations, free chlorine will slowly corrode the metallic strainer system so that deterioration may occur after some years of use. Actual conditions should be determined from time to time to prevent failure. This is of particular importance where umbrella or similar type strainers are in service since corrosion of the projections may easily occur.

Rate controllers, to be of value, must be kept functioning accurately and constantly. All moving parts must be kept oiled, cleaned and freely working. Regular inspections should be made of operating cords and cables, and when excessive wear is noted, replaced before failure occurs. To maintain accurate indicating

(Continued on page 40)

Public Works Engineering Methods and Data

Quick Mapping of Subdivision Developments for Highway Purposes

The end of the war brought on a flood of subdivision developments, says the Minnesota Highway Department. The Department was besieged with inquiries as to future highway developments and right-of-way needs. Lack of manpower had prevented making the necessary surveys to bring existing land maps up-to-date. A procedure was developed by which new maps suitable for the purpose were produced at small expense and without the aid of much survey work.

Contact prints of air photos at a scale of 880 feet to one inch were obtained from a local aerial photography firm. In the Department's own photo laboratory these were enlarged to a scale of 200 feet to one inch. A new map was then traced from the enlargements. As the air photos were taken on a recent date, only a small amount of field checking was necessary in order to locate the very newest buildings.

From these base maps reproducible layout maps were made showing the proposed new developments and the limits of the new right-of-way requirements. This procedure made it possible, within a relatively short time, to obtain maps from which information could be given to prospective builders and developers and from which all preliminary right-of-way investigations could be made.

Operating Data from the Minneapolis-St. Paul Sanitary District

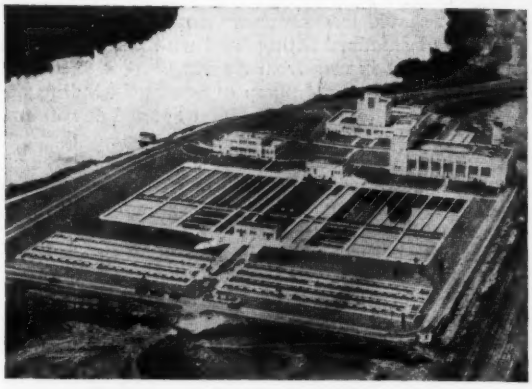
The report of this District for the year 1945, which has just been received, contains operating data of value and interest.

Screenings Removed.—Bar screens which are mechanically and automatically cleaned by a float control mechanism, have a 1-inch clear opening between the bars. In 1945, 1.0 cubic foot of screenings were removed per million gallons of sewage—the same as the preceding year. The average removal for the seven years of operation is 1.04 cu. ft.

Grit Removal.—There are eight grit chambers, each 62′9″ long, 12′0″ wide and 4′6″ to 9′0″ deep as flows vary. Grit is removed by scrapers 8′0″ wide traveling at 8′ per min. During normal dry weather flows, grit chamber velocities are about 1.2′ per sec.; during storm periods 0.6′ per sec. During 1945, 4.6 cu. ft. of grit were removed per million gallons, compared to 4.4 cu. ft. in 1944, and 5.8 cu. ft. average for 7 years.

Settling Tank Removals.—Settling tanks are 56′ wide, 290′ long and 15′6″ deep. Sludge is removed by a conveyor type mechanism with flights 18′ wide traveling at 2′ per min. With an average detention period in 1945 of 1.1 hours, the tanks accomplished a removal of 65.6% of the suspended solids and 37.0% of the 5-day BOD. Sludge was pumped from the settling tanks 3 times every 24 hours, and by rigid control of all factors, the solids concentration was kept at 8.2% during the year.

Sludge Filtration.—Sludge is concentrated in 2 tanks, each 95′ long, 18′ wide and 24′ deep, which are provided with sludge collector mechanisms and means for removing scum. There are 6 vacuum filters, each



The Minneapolis-St. Paul treatment plant.

11′6″ diameter and 14′ long, with an effective surface area of 500 sq. ft. Solids content of the concentrated sludge was 9.04%. Chemicals used for sludge conditioning were: Ferric chloride at an average dosage of 0.92% of the weight of the dry sludge solids; and lime at 2.84%, expressed on a calcium oxide basis. Ferric chloride use has decreased quite steadily since the plant started; in 1944, it was 1.16%. Lime use has also decreased. The average life of filter cloths in 1945 was 339 hours, compared to 474 hours in 1944, and 461 hrs. in 1943, the shorter life probably being due to poorer cloth, lower chemical use and more frequent washing. Filtration rate was 3.25 lbs. of dry solids per sq. ft. per hr., which was slightly below the preceding 3 years.

Sludge Incineration.—Three incinerators of the multiple hearth type have a nominal capacity of 600 tons of dry solids per 24 hours. During 1945, 82,973 tons of filter cake containing 26,629 tons of dry solids were incinerated, producing 9,661 tons of dry ash. Incineration required 7.2 kilowatts of electricity and 1.53 gals. of fuel oil per dry ton. The oil was used mainly in starting the incinerators, taking them out of service, and maintaining temperatures during short periods when incineration was not required. Fuel value of the sludge varied generally between 10,000 and 11,000 btu per pound of combustibles.

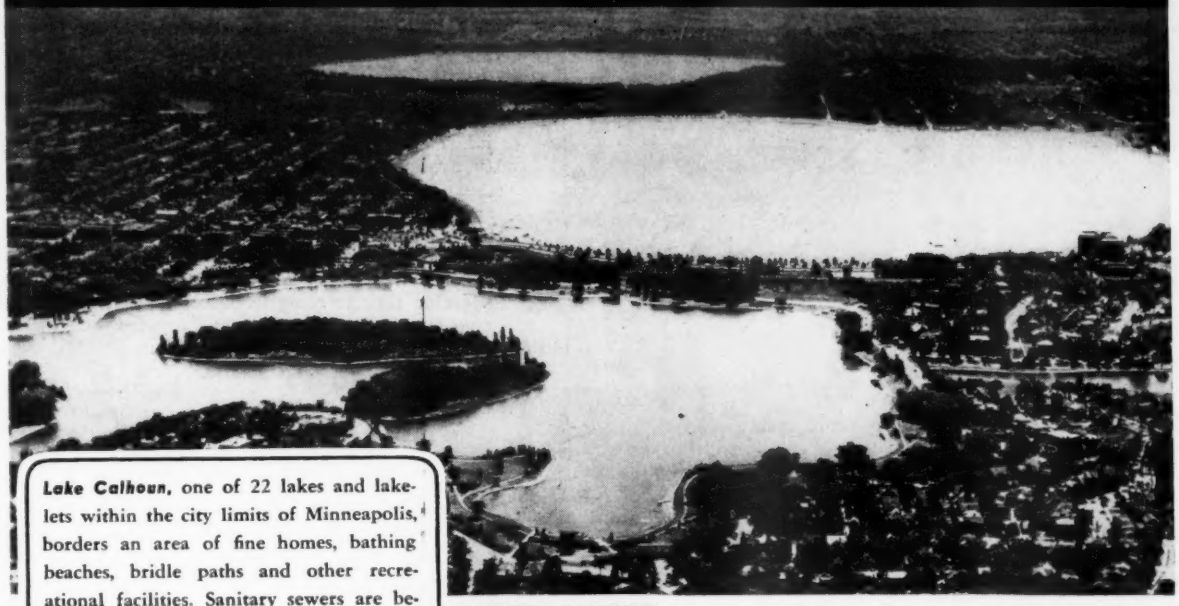
Kerwin L. Mick is chief engineer and superintendent.

Self-propelled Highway Striper Saves Money

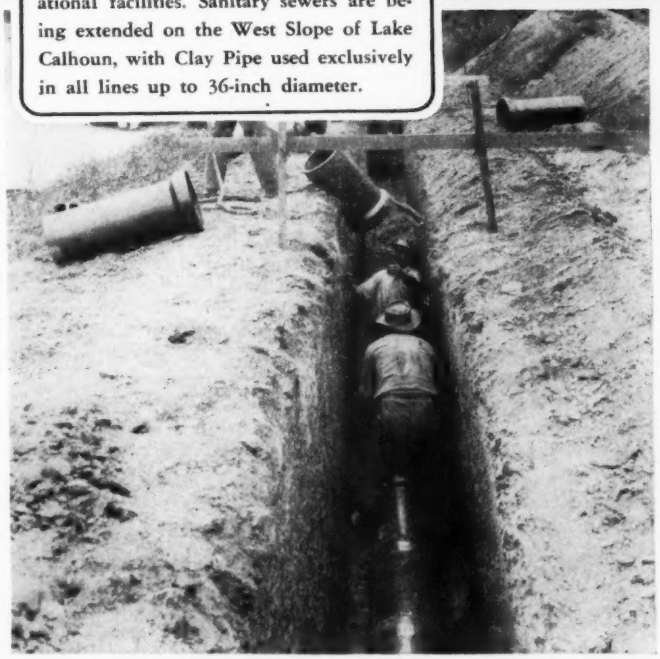
The State of Rhode Island "purchased a self-propelled striper for applying paint by the spray method and found it to be most efficient and economical. Instead of an average daily mileage of three miles for the hand-operated, gravity-fed device which applied the paint by means of a brush, the new piece of equipment, supplied with a spray gun paints 10 to 12 miles per day without difficulty. The paint is distributed so evenly that the guide line is covered its entire width and at least 20 per cent less paint is used than with the old equipment. The new striper is propelled by a 2½ h.p. air-cooled motor, has a twin cylinder air compressor, and is equipped with

CLAY PIPE

GUARDS LAND VALUES—PUBLIC HEALTH AROUND BEAUTIFUL TWIN-CITY LAKES



Lake Calhoun, one of 22 lakes and lakelets within the city limits of Minneapolis, borders an area of fine homes, bathing beaches, bridle paths and other recreational facilities. Sanitary sewers are being extended on the West Slope of Lake Calhoun, with Clay Pipe used exclusively in all lines up to 36-inch diameter.



MINNEAPOLIS is increasing sanitary facilities with Clay Pipe in some of its finest residential sections. The installation of many miles of Vitrified Clay sewers in the famous Twin City is designed to protect the lakes from pollution for many decades. Land values of bordering residential lots, bathing beaches, playgrounds, etc. are greatly enhanced, now that the threat of water pollution is removed. Engineers who specified Clay Pipe for this modernization program wanted the *best!* They knew that high-quality, corrosion-proof Clay Pipe *never* wears out! It provides the greatest possible protection . . . assures long service and true economy.

Careful Construction is important in any pipeline installation! Note the flat, level trench-bottom here . . . straight sidewalls . . . well-made joints . . . careful handling. Combine this sort of construction with the long-wearing properties of Clay Pipe itself, and you have a sewer line that gives decades of dependable service!

For information about Clay Pipe, write to the office nearest you.

NATIONAL CLAY PIPE MANUFACTURERS, INC.
571 Chamber of Commerce Bldg., Los Angeles 15, Calif.
522 First National Bank Bldg., Atlanta 3, Ga.
1105 Huntington Bank Bldg., Columbus 15, Ohio
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CLAY PIPE NEVER WEARS OUT! PIPE

C 847-1

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That's why the Clinton is in demand by users, dealers and manufacturers employing compact air-cooled power—Built by master craftsmen employing the most modern tools and equipment, the Clinton has set a new standard for performance—The Clinton enjoys an enviable reputation for economy of operation, longer service and staying power—SHOWN IS THE GEAR REDUCTION MODEL BUILT FOR EQUIPMENT REQUIRING SLOW DRIVING SPEEDS—THREE RATIOS AVAILABLE: 6 to 1—4 to 1—2 to 1 AS REQUIRED.

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a two-wheel riding trailer, the latter being a convenient adjunct for the operator. The main feature of the new apparatus is the use of air curtain guide plates which maintain a keen cut edge over any type of surface, smooth or rough, at any speed. This is accomplished by forcing compressed air or exhaust gas from the manifold through millings in the air curtains." —*Annual Report.*

Water Plant Maintenance

(Continued from page 37)

and recording gauges, weekly inspection and adjustment is frequently necessary.

The value of gauges and meters depends upon their *constant* accuracy. Frequent cleaning and oiling is essential. This is a service furnished by manufacturers and is available upon arrangement with them.

Records, Personnel and Facilities

Maintenance and repair records should be kept, and they are effective only when accurate and reflect all work done. They must not be complicated or require considerable time to compile. Except by such records, the engineer in charge cannot be assured that maintenance personnel are performing their individual jobs and meeting their responsibilities.

Either a service record or a repair record form should be used for each piece of machinery and building. Both are not necessary. These should be kept on visual card index files to facilitate daily making of entries.

Records will show the *frequency* of repair to a machine, etc., which is a major consideration when equipment is to be replaced. Correctly kept records will disclose whether a machine is worn out from normal operation, or from unsuitable work.

A well equipped machine shop is essential for a large plant. Very heavy machinery is not necessary but a drill press, shaper, lathe, power saw (wood and steel), pipe threading machine and emery wheel are the minimum needed.

Shop personnel should include a master mechanic, electrician, plumber, carpenter, welder, several helpers, above laborers in ability, and one or two laborers. These should be a part of the plant operating force in a large plant, while in a small one this help would be obtained from other sources as previously stated.

As a group, this force should have intimate knowledge of every valve, gauge, motor, pump, chlorinator, controller and other apparatus used in the plant. *At least* two men should have *complete* knowledge of each phase of the work. No one man alone should be permitted to have detailed knowledge of equipment.

The comments stated herein are based upon about 30 years' service in the Department of Public Works, Nathan L. Smith, Chief Engineer, Bureau of Water Supply, Leon Small, Water Engineer.

References

1. Hopkins, Edward S., Pub. Wks., *72*; July, *29* (1941); Water Wks. Eng. 94; 571 (1941); Water Wks. & Sew. 88; 270 (1941).

Inventory and Stock Control

(Continued from page 23)

yard so that boots can be hosed clean before the wearer enters a building.

Washing Facilities.—Adequate facilities for washing should be available in close proximity to the

cloakrooms, and at suitable points elsewhere, with a constant supply of hot and cold water. Basins, washing troughs, or wash fountains should be provided in sufficient number. As a preventive measure against the risk of contracting dermatitis the use of protective creams to be applied before commencing work is to be commended wherever an operative is engaged on dirty work.

Much dirt on walls and fittings can be avoided if the washrooms and lavatories are so arranged that a man can walk into them without passing through any doorway or touching any fitting. This will increase the cost of construction, particularly as light-colored glazed bricks or tiles should be used, but a frequent wash down with hot water will be the sole requirement to keep the place clean. This in itself is worth paying for, but if the cost of painting and decorating walls and woodwork over, say, 30 years be estimated, it will probably be found that the more expensive type of construction is cheaper in terms of net annual cost.

Working Conditions.—Working conditions are receiving more and more attention. This is not due only to the demands of the workers. Managements are appreciating that the quality and quantity of the work done are directly influenced by the surroundings in which it is carried out, and they are concerned to see that good working conditions are provided.

It is generally recognized that good lighting is essential if first-class workmanship is to be attained and spoilage reduced to a minimum. Plenty of *natural* light is bound to have beneficial effect on the health of the workmen, as well as keeping down the accident rate.

While white walls have the highest reflective powers, the slight reduction in reflection when pale colors, such as cream or primrose, are used is more than compensated by the advantage gained in absence of glare. The lay-out should enable workbenches to be placed close to the windows in the outside walls. The importance of this in the case of fine work such as instrument and meter maintenance can hardly be overestimated. The machines called upon to do most work should be located in the best part of the shop, and those for which there is least work placed farthest from the windows.

With artificial lighting the ideal at which to aim is uniform illumination throughout. Care should be taken to see that bright pools of light are not surrounded by gloomy patches, as these tend to produce eyestrain resulting from the eyes having to adjust themselves to different intensities whenever the worker looks up or moves to another part of the building.

Staff, and the Future

With the increasing use of modern mechanical appliances the number of employees at sewage works tends to decrease, but an all-around higher standard of worker is required. As the plants become more technical, the rough-and-ready methods of the handyman have to give way to precision work which can only be performed by skilled craftsmen, and the need for more skilled supervision grows accordingly.

A sewage works manager today has to combine the wisdom of Solomon as an administrator with the technical knowledge of the chemist and engineer. He cannot do his job efficiently unless he is given adequate assistance in each of these phases of his work, and the necessary office, laboratory and workshop equipment. On all but the smallest works a manager cannot do routine work, be it in workshop, laboratory or office, except at the expense of reduced general supervision, yet it is deplorable to see with

STATE CAPITOL, ALBANY, N. Y.

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Cities, processing plants and manufacturing firms throughout the state of New York now own more than three hundred and twenty-five Layne high efficiency Well Water Systems. These individually designed, quality built and correctly installed water systems are now producing millions of gallons of water daily at an amazingly low cost.

Into all Layne Well Water Systems only the very finest quality materials have gone, thus providing the absolute maximum in long life with a minimum of upkeep cost.

Layne Well Water Systems and Vertical Turbine Pumps possess many distinctive and definitely superior features that have been developed and thoroughly proven by Layne. Engineers the world over readily recognize Layne Well Water Sytems as being the best that money can buy.

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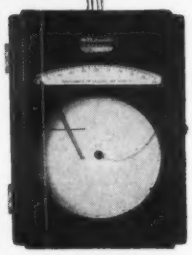
New!



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Over any distance

INSTALLS ON PROPELOFLO OR ANY MECHANICAL METER

Builders new electrically operated transmitter and receiver greatly broaden the applications of any mechanical flow meter. No longer is it necessary to go into manholes and inaccessible locations to read a meter. Complete chart records and rate of flow as well as exact total of flow can now be had at any point, however remote. The recording chart has uniform graduations throughout its range — a special Builders feature. Alternating current is used at the receiver; no power required at the meter.

Builders Propeloflo meter is well adapted to remote operation . . . ***only two wires are needed*** to transmit complete flow information to the main building. The new transmitter greatly broadens the usefulness of the Propeloflo, already extensively used as a main line meter. The streamline Venturi design of this Propeloflo meter creates uniform velocity distribution where the flow meets the propeller, giving exceptional accuracy over a wide range with low head loss. For Bulletin C11-380.21, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 16 Codding St., Providence 1, R. I.

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what meagre facilities and staff he is often expected to carry out his job.

As an enlightened Committee of an enlightened Council, the Sewage Committee will appreciate that sewage purification is a *vital* public health service for which only the highest standard is good enough, and will determine to see that that service is invariably viewed and treated as a *vital* function.

In common with all elected members of local councils, members of Sewage Committees are busy people, and they cannot and should not be expected, to be masters of the subject technically. In the course of time many do acquire an appreciable knowledge of it, but their prime function is to decide matters of policy, and to do this they must be competently advised. Only men with specialized knowledge and experience are competent to give this advice.

In the medium-sized and larger authorities it is usual, of course, to have a sewage department with a chief officer who is adviser on all matters pertaining to sewage treatment. Smaller authorities cannot be expected to have such a qualified adviser on their staff, but in these cases it is of no less importance that the best advice should be obtained, for the best advice is always the cheapest in the long run.

Therefore, it is suggested that the first requirement in servicing a sewage works is that the responsible Committee shall secure the services of suitably qualified and experienced officers or consultants to give them all the advice and information necessary to enable them to shape their policy, and, when that policy has been determined, to carry it into effect speedily and effectively.

Breadth of vision and courage in planning are urgently needed: the policy of "make do and mend" long applied has left us with numerous overloaded and inefficient plants, and new works are in many instances long overdue.

Resurfacing With Hot Plant-Mix

(Continued from page 28)

size aggregate of 1½ inches. The 3 inches was laid in one course.

The fourth section was a 2-inch hot plant-mix using the same aggregate and mix as was used on the base course for concrete pavement. The fifth section was a two course hot-mix pavement, 2-inch base and 1-inch top. These courses were the same as used on the concrete pavement. The sixth section was a one course hot-mix pavement, 1½ inches thick, and the same mixture was used in the top course of the concrete pavement.

The Vermont Highway Department has received many favorable comments on the smooth riding qualities of the hot-mix bituminous concrete type of surface. The gradation of the material in the top course gives a tight, smooth surface, but, due to its texture, is not slippery when wet. The application of salt and chloride in winter maintenance is not injurious to this type of pavement.

There are about five miles of paving left to be done in 1947 from the present plant set-up, and then the plant will be moved to the Rutland area where about 20 miles of concrete pavement is to be widened and surfaced with bituminous concrete. The aggregate for this operation was crushed and stockpiled by a State-operated crushing plant during the summer of 1946. It is the intention of the Vermont Highway Department to crush and stockpile the aggregate one year in advance of paving operation.

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Waterworks Digest

Free Residual Chlorination at New Haven

Prior to April 1944 the New Haven (Conn.) Water Co. used the chlorine-ammonia process to prevent the development of bacteria in the mains. The result was satisfactory, but at that date free residual chlorination was substituted to obtain greater bactericidal efficiency. This necessitated increasing the chlorine dose from 0.61 ppm to 1.36, the residual being thus increased from 0.23 to 0.70 ppm. The number of gas-forming bacteria, as shown by the lactose broth tubes of the presumptive test after 48 hr. incubation, was reduced from monthly percentage of 43 in 1943 to 11 in 1945. Such bacteria are usually non-confirming types, but their elimination provides an additional factor of safety. The application of free residual chlorine has permitted a more scientific method of control, whereby more uniform and improved taste and odor control, as well as bacteriological results, is obtained.

Free residual chlorination has improved the taste and odor of waters containing *Asterionella, Uroglena, Anabaena* or *Dinobryon*. In the case of one supply using lime treatment for corrosion control, the higher chlorine rates caused iodine-like tastes. The substitution of sodium hexametaphosphate resulted in improvement in the quality of this supply.[A22]

Protection Of Reservoirs

Protection of the purity of a stored water supply is best obtained by complete ownership of the surrounding lands. One Massachusetts city purchased an ice pond and suspended cutting of ice on it; before which, each year after ice cutting, coliform organisms had been found in 0.1 ml, but after the purchase no coliform organisms were found in 1 ml samples and nearly all 10 ml portions were negative. Another city which closed its watershed as a wartime precaution found the average plate counts only 20% as high as before the war, and coliform organisms practically disappeared.

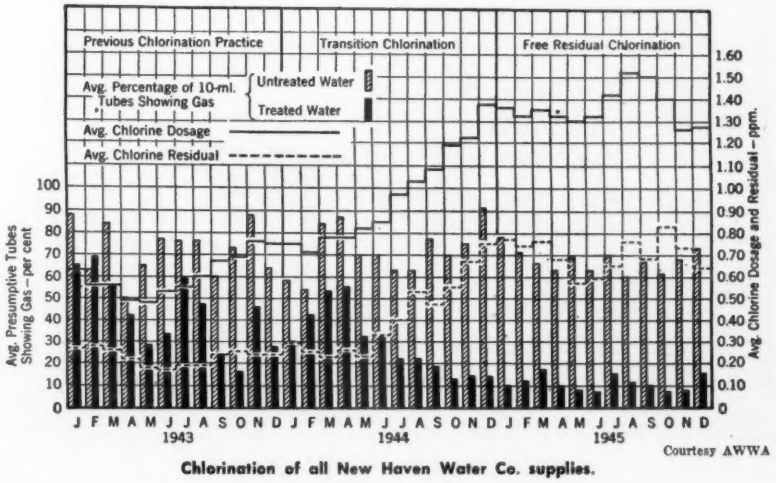
Storage for 30 days of the highly polluted Merrimac river water considerably reduced suspended solids, iron and organic matter, and reduced the bacteria from 37,000 to 280 per ml at 20°C, and a similar reduction of coliform organisms. However, Metropolitan Boston water, after a very long storage period, for long periods showed practically 100% fermentation in all tubes; a careful study finding that the synergistic action of two and sometimes three different bacteria is responsible for these fermentations, and at least 10 ppm. of chlorine was necessary to prevent this gas formation. So far no sanitary significance has been attached to this.

New Hampshire finds much contamination of water supplies due to lumbering operations on the watershed, especially where horses are used; and even more to wild animals, especially beaver.[A25 & 26]

Odor Control by Chlorine Dioxide

Northampton, Pa., had been using copper sulphate in its impounding reservoir and a little in the distribution reservoir to prevent algae-caused tastes and odors; followed by 3ppm. of carbon and 0.75 ppm. of chlorine in pre-treatment, and 0.6 ppm. of ammonia and 0.5 ppm. of chlorine in post-treatment. But in April 1946 it began use of the chlorine dioxide treatment, entirely eliminating the use of carbon and ammonia, but using enough chlorine to give a flash chlorine residual after filtration of 0.40 ppm., requiring 1.0 ppm. of pre-chloride dose.

The sodium chlorite was fed by a W. & T. metering pump into the post-chlorinator discharge on its way to the clear well. The 0.4 ppm. residual leaving the plant gives a 0.05 ppm. at the extreme end of the distribution system. This not only removed the taste but reduced the bacteria count on agar. Using 1 ppm. of $NaClO_2$, all tastes were prevented, even when the algae


Previous Chlorination Practice
Transition Chlorination
Free Residual Chlorination
Avg. Percentage of 10-ml. Tubes Showing Gas
Untreated Water
Treated Water
Avg. Chlorine Dosage
Avg. Chlorine Residual
Avg. Presumptive Tubes Showing Gas – per cent
Avg. Chlorine Dosage and Residual – ppm.
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1943
1944
1945

Courtesy AWWA

Chlorination of all New Haven Water Co. supplies.

count reached 820 algae per c.c. and no copper sulphate or carbon was used.[X12]

Columbia, Pa. water from the Susquehanna river had a muddy or black color (from coal mines), persistent odors, and severe but sporadic chlorophenol tastes and odors. Treatment included pre-chlorination, lime and alum, activated carbon, sedimentation, filtering and post-chlorination, post-lime and at times post-ammonia application. Use of chlorine-dioxide treatment as at Northampton left high color in the clear well. Applying this treatment half way through the sedimentation basin was tried, but iron and manganese clogged the filters. Finally the chlorine dioxide was applied at two points—in the raw water to precipitate chemicals and in the clear well to control phenolic tastes; and the pre-chlorine dose was increased to 80 lb. per million gallons, which gave a plant residual of 0.25 ppm. Disinfection has been satisfactory, phenolic tastes reduced to a minimum, and precipitation of iron and manganese much improved; but some chlorinous odor and river taste remain. Manganese is completely removed.[X13]

Royersford, Pa., takes water from the Schuylkill river, with turbidities ranging from 50 to 3,000; odors from 15 to 100 on the odor scale, reduced to 3-5 by carbon. Chlorine dioxide treatment was begun in November 1945. Prechlorination was increased from 8 to 20 lbs. per mg., and chlorine dioxide applied at the clear well, replacing post-chlorination and ammonia. After about ten days, chlorinous tastes appeared at consumers' taps and sloughing of tubercles began. Then the chlorine-dioxide treatment was discontinued except when tastes and odors appeared. They consider chlorine-dioxide helpful in reducing certain tastes and odors and decidely helpful in removing iron and manganese.[X14]

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TROY, N. Y.

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 69-73*

Designing A Pump House

A pump house over a deep well should be of ample size to house, not only the pump, but also all auxiliary equipment such as chlorinator, automatic panel board and metering devices; also a desk and chair and hand tools. It should be substantial and weather tight. The roof should be strong enough to support the load imposed by installing, repairing and replacing the pump and pulling the screen. Heavy metal window screens are desirable to prevent vandalism. The house may be heated electrically, but gas heaters automatically controlled had been found to be more satisfactory and less costly. A cellar under the main floor to contain piping, wiring, meters, chlorine tank and scale, was found to offer conveniences fully worth the additional cost.[P4]

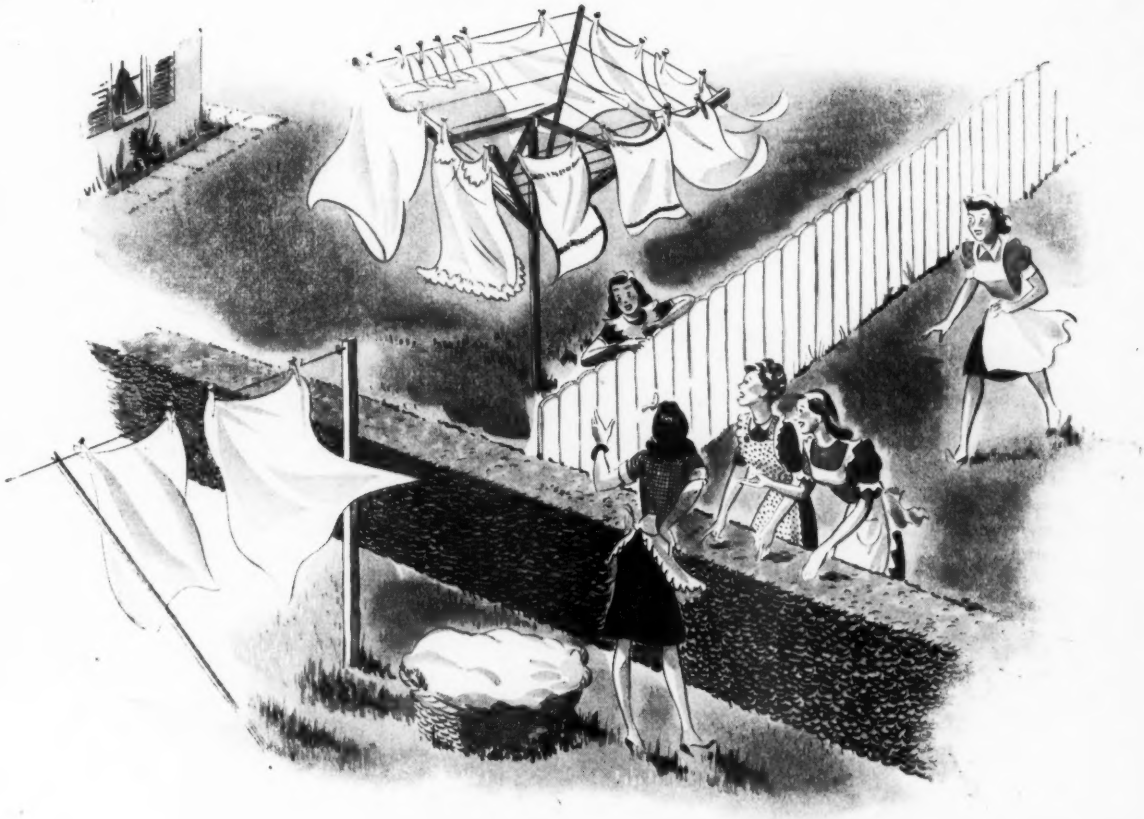
Odor From Starch Wastes

At Presque Isle, Me., the raw water has a highly disagreeable odor caused by the fermentation of starch wastes which are discharged into the water supply about 5 mi. upstream from the treatment plant. Combinations of high chlorine and ammonia dosages, activated carbon, alum, lime, flocculation, coagulation and rapid sand filters and even chlorine dioxide have failed to remove enough of the odor to make the water even barely palatable. No practicable solution has been found except to prevent the starch wastes reaching the stream.[A24]

Forest Management

Newark, N. J., owns about 35,000 acres of the watershed that supplies its water and began forestry on it in 1906. By 1932 about 300 acres of trees had been planted, about 80% conifers, and a resident forester was placed on the watershed. With the help of the CCC 24 miles of truck trails were constructed for fire control and logging; also 10 miles of fire break; a steel fire tower; water holes; spring holes; foot bridges; picnic tables; fireplaces; and latrines. To date, 2871 acres have been planted, reduced to 2400 by fire, deer and drought. Most of the plantings are conifers, with some native oaks and other hard woods. Dead and diseased wood is removed, and control of insects and disease maintained. Wood is sold but only such as will increase the

THE WHOLE TOWN'S TALKING!



Every housewife in town is bursting with the exciting news of snow-white washes, with less effort, less soap. The reason? Their city management has installed modern, efficient Permutit* Water Conditioning equipment. It's the biggest thing that has happened in years.

From now on, municipal water will be clear...soft...iron-free! And good water does more than end household drudgery; it benefits everyone in town—shops, restaurants, and industry!

If your community has a hard-water problem—and the chances are it has—why not let the engineers of America's most experienced water-conditioning company solve it for you. Write today to The Permutit Company, Dept. PW3, 330 West 42nd St., New York 18, N. Y., or Permutit Company of Canada, Ltd., Montreal.

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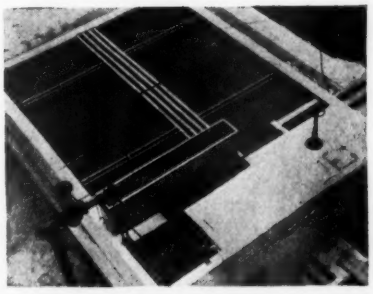

PERMUTIT SPAULDING PRECIPITATOR ... removes water hardness, dirt, and color by the sludge blanket process. This modern equipment cuts detention time, saves chemicals, takes only half the space of former methods. This is only one of many Permutit methods of treating municipal water supplies.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 69-73*

productivity of the forest or the quality of the stand, or to salvage burned or dead stumpage. In 1945 the city received from live timber stumpage $3,214, $754 from dead timber stumpage and $387 from Christmas greens. In 1943 it sold Christmas trees for $9,578. The trees to be cut each year are marked by the forester and sold by contract on the stump. The buyer places a cash deposit with the city for proper performance. The logs are scaled in the field as cut, and paid for as removed. It is expected that eventually there will be an annual cut of 4,000,000 to 6,000,000 fbm of lumber and 5,000 cords of wood.[A27]

Standards For Water Services

Richmond, Va. adopted standards for water services in 1944, and finds that it saves money to both city and customers, reduces service complaints, and insures uniformly convenient water pressures on consumers' premises. A standard minimum pressure of 35 psi at street level was adopted; it is not guaranteed, but every effort is made to maintain it. Office buildings are not sure of more than this pressure, and the owners should provide for pumps and storage tanks if this does not give sufficient pressure on the top floor.

It is assumed that the service and meter will absorb 7.0 psi, the building piping 4.3, and that the residual pressure at the outlet should be 4.3 lb.; leaving 19.4 lb. or 44.7 ft. for elevation of outlet above the street. The size of service pipe and meter which will give the desired rate of flow with a friction loss of 7 lb. or less is calculated. When a service is to be installed, the plumber informs the department of the number and types of appliances to be installed and distance from the street line to the first branch pipe from the service, from which the department determines the size of pipe and meter to be used. It has assumed certain demand factors for each type of fixture—5 gpm for a domestic sink with two outlets, 6 gpm for a tub, 4 gpm for a lavatory, etc. The sum of all the demand factors is multiplied by a number varying from 0.72 if there are two outlets, 0.32 if there are ten, 0.22 if there are twenty, etc., and the product used in selecting the size. [A16]

Phosphates in Fluoride Determination

It is definitely known that iron, aluminum, sulfates and chlorides interfere with the determination of fluoride by the decolorization of a zirconium-alizarin lake, but the effect of phosphates was not definitely known until recent investigations showed that they interfere with these determinations, giving false positive results. Metaphosphates interfere more with the fluoride determination than the orthophosphates do. Increasing hardness values of the water decrease this interference.[A20]

Useful Life of Wells

In a discussion of this subject by eight waterworks men, the following opinions, among many others, were expressed. One cause of well failure is overpumping. This does not usually result in permanent damage in a consolidated formation, but in an unconsolidated one it frequently necessitates repairs. For rock wells in Wisconsin it was concluded that if the water level is not drawn down more than 60 ft. below static level, the well is not being overpumped.

Many wells collapse because screens or casings are too light. Most stoppages of screens in unconsolidated formations are due to a hard crust of sand and gravel over the screen openings, which can be removed and the screens replaced. On Long Island salt intrusion so corrodes screens that they go completely to pieces in 6 mos. Blasting is the most commonly used method of restoring rock wells. Those in unconsolidated formation have been restored by blowing with air, surging by intermittent pumping, brushing, acid treatment, agitation with a plunger, or combinations of these.

Investigation of 320 municipal wells in sand or gravel showed that 285 of them had been abandoned, 280 because of screen clogging and incrustation. Of the wells in service, the average life was 14.8 yr., the maximum life 32 yr.;

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of the abandoned wells, the average life was 6.1 yr. and the maximum life 45 yr. Tubular wells 6" to 16" diameter built recently are expected to have a life of 50 yr. Older wells, 6" and 8", of which 339 were investigated, have an average age of 40 yr., but their useful life has averaged about 30 yr. If well constructed, such wells should have a life of 50 yr., and rock wells 100 yr.[A17]

Up-to-Date Purification Equipment

Oklahoma City has completed construction of a 15 mgd. plant which seems to embody most of the latest improvements in water treatment. The intake is protected from fish by an electronic fish screen. Water is pumped by dual-motor pumps, a 10 mgd. pump powered by a 40 hp. motor for low lift and a 100 hp. motor for high lift. The water is recarbonated by burning natural gas under water, controlling its operation automatically by a pH recording meter. The filters contain anthrafilt, and are washed by Palmer surface wash. Calgon is used to stabilize the water. The washwater tank is protected against rust by the cathodic action of Rusta Restors.[J3]

Water Rates In a Small Town

A study of water consumption and rates at Alma, Mich. for the five years 1941-1945 showed that the consumption had increased 87%—from 314 mg. to 587 mg; but meantime the revenue dropped from $95.05 per mg. billed to $70.55. Domestic consumers had used 13.62% of the water and paid 51.46% of the revenue; commercial consumers used 8.08% and paid 11.95% of the revenue; and industrial consumers used 78.3% of the water and paid only 36.59% of the revenue.

The last item showed the answer. Domestic rates averaged 38.0 cts. per 1,000 gal.; commercial rates averaged 12.7 cts., and industrial rates only 4.2 cts. An analysis of the cost of supplying water showed that this was 8.5 cts., or more than twice what the industrial consumers paid. This cost consisted of 3.15 cts. for production, 1.58 cts. for distribution, and 1.37 cts. for commercial operations; with an estimated depreciation of 2.41 cts.[A4]

Algae in St. Paul Water

St. Paul, Minn., obtains its water supply from the Mississippi river, first pumping it into two lakes—Pleasant and Vadnais, which are remarkably similar. Algae are present in the river water, but more abundant in the lakes, the diatoms being the most troublesome, the blue-green next, then the green algae. The diatoms are found most abundantly when the water temperature is between 55° and 60°; the blue-green at 65° and over, the green in small numbers at all temperatures in the growing season. In the

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How, for example, will some normal settling of the terrain affect the joining of those lines? And if, in the course of events, minor leaks develop, will they have to be dug up for repairs?

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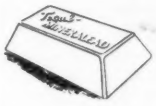

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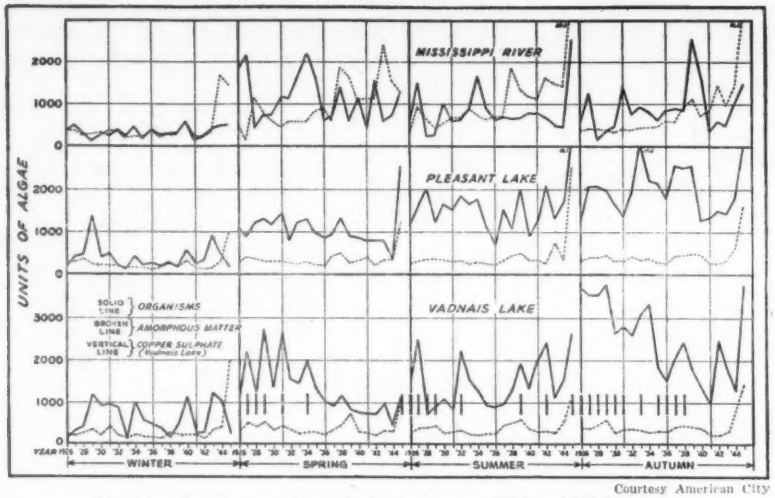

Courtesy American City

Variations in algae population in St. Paul water, 1926 to 1945, inclusive.

years 1931-1935 there was a drought and low water flow in the river, and algae flourished. In 1936-1944 the rainfall was higher and the organisms decreased while the amorphous matter increased. The river temperature decreases in the autumn faster than that of the lakes, thereby slowing down the algae growth, while heavy rains increased the amorphous matter.

Vadnais lake has been treated intermittently with copper sulphate since 1915 at a rate of 2 lb. per million gallons. The copper sulphate content rapidly decreases and completely disappears in 48 hr. At the end of 3 or 4 days it either has removed 90% of the algae or is a total failure. The dead algae require from 5 to 7 days to disappear. Copper sulphate seems to have little effect on the stephanodiscus type of algae. There seems to be little or no correlation between annual precipitation and algae growth; but the temperature of the water determines the rate of growth and type of plant.[J5]

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January 22

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Purification and Water Quality In St. Paul

The 1945 report of the Water Commissioner of St. Paul, Minn., states that 1.67% of the water filtered was used for back washing the filters, the period between washings averaging 77 hours. The plant influent had a turbidity of only 2.3, and a color of 35.0. An average of 14.4 ppm. of aluminum sulphate; 0.128 ppm. of ammonia; 0.93 ppm. of chlorine; 114.5 ppm. of lime; 18.7 ppm. of sodium carbonate; and 0.40 ppm. of activated carbon were used. The total cost of chemicals per mg. was $6.16. The average colon index of the raw water was 25; of the coagulation basin effluent 9.C0; of the filters 2.87; of the plant effluent, 0; and of the distribution system 0.73. Except for September, October and November, the colon index of the distribution system was also 0. The report states that "in the autumn of 1945, several breaks in the piping of the distribution system occurred."

The average cost of purification and softening in 1945 was $14.71 per mg., of which $6.134 was chemical cost, and $2.878 was operating labor. A new pH indicator was installed which resulted in improved control of operation and a considerable saving in cost of lime.

The average hardness of the water was reduced 79 ppm., at a cost of about $7 per mg. The cost for soap, based on only 1% of the water consumed, for the same softening would have been $12.64.

Repairing Service Pipes

An English firm has developed a method of repairing service pipes by forming an ice plug in the pipe to shut off the flow, using either a small portable mechanical refrigerator operated by either electric motor or gasoline engine, or a refrigerant such as solid CO_2. A clamp surrounds the pipe at the point of freezing to prevent damage to the pipe by expansion of the ice plug during freezing.

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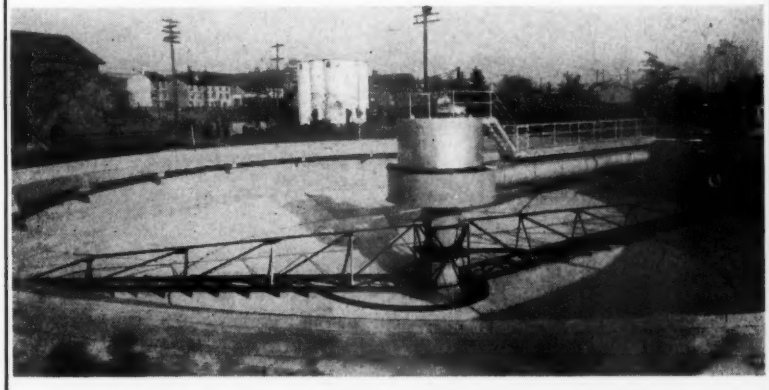

in a HARDINGE Thickener, for Example

Here illustrated is a 110' Hardinge Thickener, installed at Norristown, Pa., removing silt from 8000 gallons per minute of chemically treated river water. The "Auto-Raise" drive mechanism—which absolutely prevents overload breakage—is but one of the features that hold maintenance of this thickener to a minimum.

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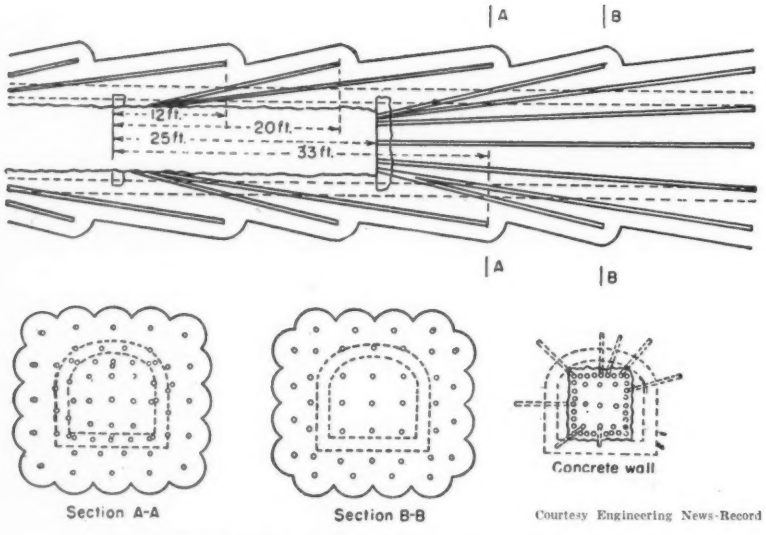

Diagram of borings made to permit grouting of faulty rock.

Tunneling Through Grouted Rock

In constructing 12,000 ft. of 48" outlet sewer at Copenhagen, Denmark, the contractor preferred to place it in a tunnel 90 to 100 ft. below the surface, rather than in a trench under water as much as 50 ft. deep. The tunnel was excavated through limestone, 7 ft. high by 8 ft. wide. Borings had indicated that the rock was solid, but after the tunnel had progressed 1200 ft. toward the shore from a shaft at mid-length, it ran into faulted rock from which water poured into the tunnel at the rate of 110,000 gph. To pass this 1,000 ft. of faulted rock, the sewer was laid in a trench near the surface, and connected to the tunnel by a shaft at each end. However, it was necessary to tunnel through 250 ft. of this faulted rock before reaching a point where a shaft could be driven. To do this, a 16" concrete wall was constructed at the tunnel heading with its ends grooved into the rock sides so that the water was stopped. Then about forty 1½-in. dia. holes 12 ft., 20 ft. and 33 ft. long were extended forward through this wall and into the rock alongside the tunnel line with 40 lb. pneumatic drilling hammers. Finally cement grout was pumped into these holes by pneumatic piston-pumps under pressures up to 200 psi. Thus the tunnel was advanced 25 ft., after which a new wall was constructed and the drilling and grouting repeated.

Almost three tons of very scarce cement were required per foot of advance, but the tunnel was made tight.[E3]

Vacuum Filtration Of Digester Scum

At the Cleveland, O., Westerly plant, scum accumulates on the digesters to a depth of 7 or 8 ft. with a solids content up to 27%; but have been reduced to normal depth by scum recirculation and removal. The scum withdrawn was pumped to a sludge storage tank. A total of 345,000 gal. of scum, containing 212,000 lb. of dry solids, was removed from this tank, mixed with digested sludge, vacuum filtered and incinerated. The practicability of vacuum filtration of mixtures of digested sludge and scum was demonstrated. The presence of the scum improved the general filterability of the sludge considerably, producing sheets of cake that were thicker than normal and broke off in rather large sections. Some difficulty was experienced with clogging of the piping due to the large amounts of coarse material usually present when scum was handled. This coarse material also increased the normal hazard of objects being caught between the filter scraper and screens, resulting in torn filter cloths.[H10]

Treating Cannery Wastes

In treating cannery wastes, mechanical screening and sedimentation are essential. Addition of lime, about 4 lb. per 1,000 gal., to the tank effluent to give a pH value of not less than 60 is an advantage. A further reduction of the organic load may be effected by passing the settled effluent through clinker-filled channels. By diluting this effluent with two or three volumes of filter effluent and filtering it at the rate of about 100 gal. per cu. yd. per day for ten hours a day, a satisfactory effluent was obtained. Sudden changes in the composition of the waste waters, as from rhubarb to carrots on alternate days, and from 80 to 520 ppm. of BOD, did not affect the result.

The channel referred to was 900 ft. long, 3 ft. wide and 10" deep, filled with clinker and limestone chips. Settled waste passed through this at the rate of 20,000-25,000 gpd. for 10 hrs. a day. It acted as a horizontal filter. When the clinker clogged with slime it was replaced with clean clinker. On an oxygen-consumed basis, the channel effected a purification of 6% to 13%.[D7]

Distilleries Pay For Use of Sewers

Two distilleries in Baltimore County, Md., pay the county for the privilege of discharging their excess stillage into its sewers, at the rate of $1.37 per thousand gallons plus $25 a week to cover additional inspection and anticipated maintenance costs.[H11]

Considerations in Sludge Digestion

Digestion has not reached the degree of perfection of other sewage treatment processes in performing its role of destroying the organic matter in sludge to produce (1) an inoffensive residue (2) of reduced bulk, which may be (3) easily dewatered due to reduced water binding properties. In operating a tank, sludge should be added to each primary digester as frequently as possible, which will give more uniform gas production and sludge with lower moisture content. Sludge withdrawals also should be made frequently in small increments. In two-stage digestion, care must be exercised in transferring material from the primary to the secondary tank.

The temperature, generally 90° to

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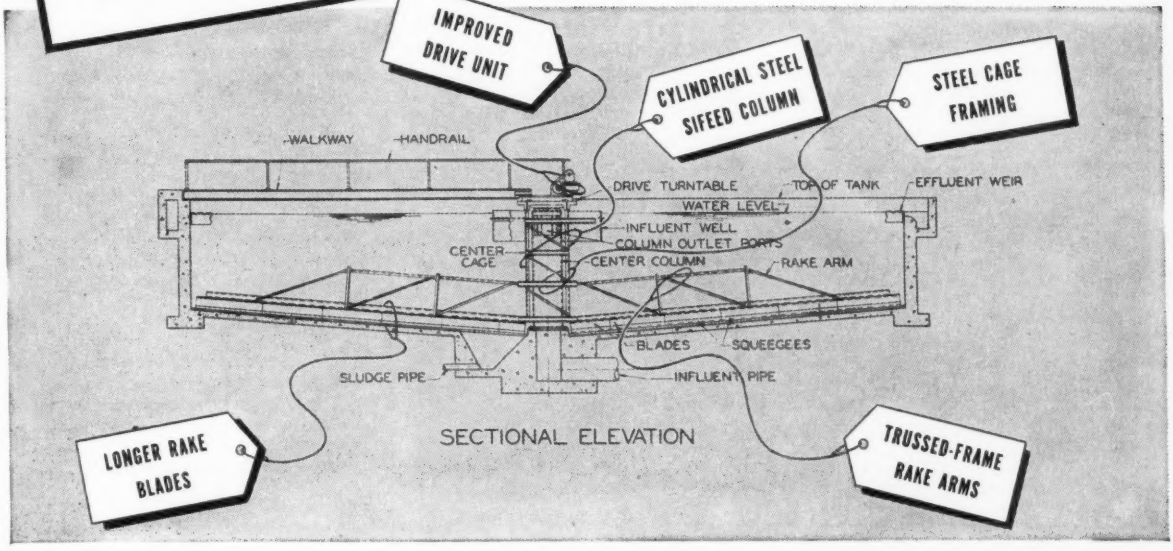

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95°, should be uniform throughout the entire depth of the tank, and maintained within a narrow range of a few degrees.

"Lime in any form or amount has no place in a digester." Conditions for proper digestion are not obtained by adjustment of the pH, which is a symptom rather than a cause. Instead, volatile acids control is advocated.

Supernatant, when discharged in large volume, or high in suspended solids and BOD, is exceedingly damaging to the main treatment processes; much less if discharged into the secondary treatment units than into the primary settling tanks. The supernatant should be withdrawn at a continuous slow rate from that part of the tank where the suspended solids content is lowest.[C16]

Not until recently has it been possible to isolate the bacteria responsible for the fermentation that produces methane; but it now is "feasible to prepare cultures in large quantities which would carry a sufficient number of the proper organisms so that a reasonable amount of inoculum would insure rapid digestion in a new tank or in an old tank which is operating unfavorably."

Fermenting organisms seem to require a certain amount of surface for their propagation, and when dissolved substrates are employed, some sort of inert surface must be supplied—shredded asbestos has been used for this purpose. The volatile acids, which are intermediates in the decomposition of higher compounds, must not exceed 2,000 to 3,000 ppm; if they do, gas formation decreases, and all fermentation ceases in 24 to 48 hr. The addition of an alkali is of little use, and may in fact stimulate the production of acid. Scum is objectionable because it constitutes a zone of high substrate concentration in which a high concentration of acids is likely to develop.[C17]

Jointing Pipe With Grouting Machine

Tacoma, Wash., has constructed 8 miles of reinforced concrete pipe sewer 24" to 54" in diameter, lying 5 to 10 ft. below the water table, the discharge from which would have to be pumped; therefore tightness was essential. This was secured by using a new method of jointing, which was so successful that it will be used for all future sewers in that city. The process is similar to guniting, but uses a special nozzle ⅜" in diameter operating on 35 lb. pressure. The sand and cement are mixed dry in the machine by means of air jets and the dry mixture is mixed with water at the nozzle and directed into the joint. In beginning a joint, water alone is forced into it, washing it clean, followed at once by the grout, beginning at the bottom of the joint. Under the worst condition a joint is completed in 5 to 8 min. The grout makes a perfect bond with the concrete, and is very hard as soon as placed.[E4]

Income From Treatment Plant

Des Moines, Ia., derives an income from the sale of grease, sludge gas and sludge. The grease skimmed from the tanks brings about $2500 annually, at 1¼ cts. per pound. The city has contracted with a company to pay it $2.00 per ton, dry weight, for the privilege of drying, grinding and sacking the sludge; paying $3 per ton for all over 5,000 tons a year.

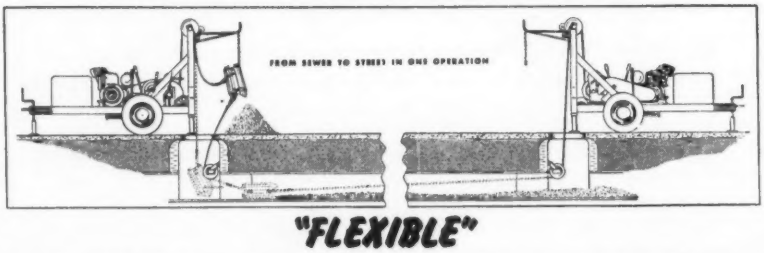
The sludge gas is sold to the local utility at the rate of 2½ cts. per therm in summer and 3½ cts. in winter, the plant purchasing current from the utility for pumping and other purposes, paying 1 ct. per kwh; the cost of current being more than offset by the return from the gas.[J3]

Effect of Moisture Content on Digestion

Reducing the moisture content of raw sludge from 95% to 70% reduces the volume occupied to 1/6 the original volume. Such concentration before digestion would permit the use of much smaller tanks and much less gas for heating them. The question of what effect such concentration would have on digestion was investigated, and "the experiments indicate the possibility of digesting raw sludge that has been dewatered and properly seeded." Reducing

OVERLOADED SEWERS?

MANY CITIES ARE NOW PLANNING ON CLEANING, TO DETERMINE THE CAPACITY BEFORE INCREASING LINES



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the moisture content to 67.5% materially retarded digestion, but it increased gradually as the moisture increased to 85.1%. Gas production decreased to a minimum of practically zero as 85% moisture, but there was considerable liquefaction of the solids. Getting the thickened sludge into and out of digestion tanks would present new problems. Digesting dewatered sludge would probably eliminate the scum and supernatant problems.[C18]

Grease at Army Camps

At army camps, grease accumulated in sewers and sludge pipes, as blankets several feet thick in primary digesters, and in trickling filters. Sewage lift stations operated by float control ceased to operate regularly because grease accumulated in the float tubes; but this trouble was eliminated by substituting a ball float with three guides. Grease interfered with the drying of digested sludge on sand beds, forming a leathery surface, which trouble was relieved by use of alum. Another solution was to discharge the digested sludge directly into a tank truck and spread the liquid upon the land.[H7]

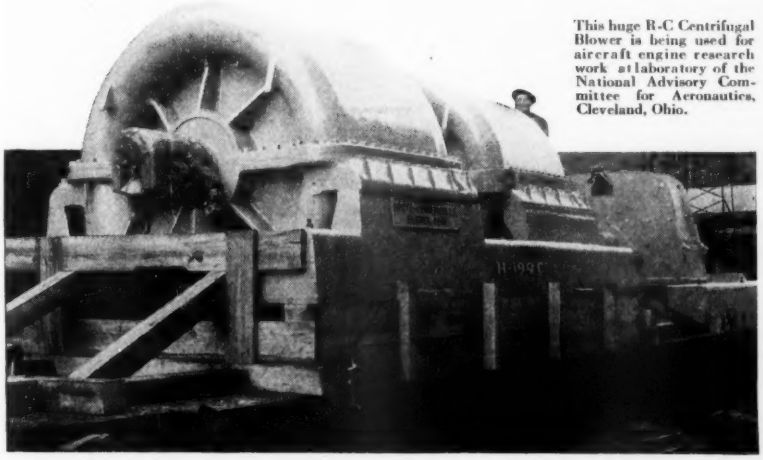
Phosphates In Sewage

Little specific knowledge is available regarding the role phosphorus plays in sewage purification. Phosphates are important as an ingredient of fertilizer, and in the self-purification of streams. The quantity discharged by humans is fairly constant; the amount of P_2O_5 in domestic sewage varies from 1.5 to 3.4 grams per capita per day. From 50 to 60% of it is removed by settling, 75 to 80% by settling and trickling filters, and 80 to 90% by the activated sludge process.[C19]

Digesting Garbage With Sewage Solids

Marion, Ind., in 1941 began discharging garbage, ground in a Jeffrey grinder, into the raw sewage wet well, whence the combined sewage and garbage passed through a grit channel, preaeration tanks and sedimentation tanks. The sludge from the last was pumped to digesters, which required too much of the operator's time; the load on the activated sludge unit was increased by the release of colloids and solubles from the finely ground garbage; and a large amount of floating material got past the grease skimmers and collected on the weirs of the final settling tanks. It was thought that these objectionable features might be avoided by getting the garbage into the digesters without first mixing it with the sewage, which was begun in 1943, the ground garbage being deposited in a separate well and pumped from this into the digesters by a Chicago single-piston plunger pump. The gas produced is of a quality that permits its use in gas engines and boilers. The loading of

Freight car loaded with **WIND**



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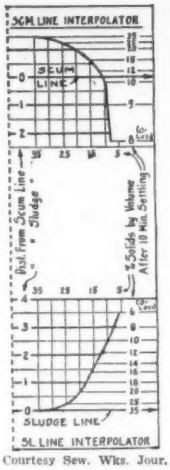
0.1 lb. of volatile solids per cu. ft. of primary digester capacity per day is too great to allow withdrawal of clear supernatant from the digestion system, with two-stage digestion at 90° F.

Test of the gas-producing qualities of garbage alone gave an average of 13.1 cu. ft. of gas per lb. of garbage volatile solids. There were indications that some types of garbage produce large volumes of gas that has little fuel value. In general it seemed that a given weight of volatile material in garbage would produce a greater volume of gas than a similar weight of sewage solids.[C20]

Locating Sludge And Scum Lines

The digester at the Grass Island plant, Greenwich, Conn., is provided with permanent sampling pipes 3 ft. 9 in. apart in elevation. Desiring to obtain a continuous record of the varying depths of scum, supernatant and sludge without having to measure from the top of the tank, the operator draws a sample from each sampling pipe and from an examination of these estimates the locations of the sludge and scum lines. In order to do this more accurately, a method has been developed as follows. A quart sample is drawn from each pipe, allowed to settle for 10 min. and the percentage of solids content of each computed. Liquid containing less than 35% of settled plus floated solids is regarded as supernatant. To permit interpolating for elevations between those of the sampling pipes, a chart was prepared by comparing the percentages of solids with the locations of the sludge and scum lines as determined by actual measurements taken from the top of the tank. For example, if the sample from point 3 contains 12% suspended solids, the chart (see illustration) indicates that the sludge line is 2 ft. below this point.[C24]



Courtesy Sew. Wks. Jour.

Chart for location of scum line.

Treating Tomato Canning Wastes

All the waste waters from tomato canning are highly polluting. A system of operating the plant and treating the wastes was developed which completely eliminated pollution of the stream, recovered waste materials which are sold as stock food, and utilized the now-recoverable wastes for fertilizing and irrigation. The plant uses water from wells which is chlorinated and used for washing the tomatoes, and then enters a flume where recirculated water conveys the tomatoes to the process machinery. Surplus water, containing broken and spoiled tomatoes, is pumped from the flume to a rotary screen. The solids removed by the screen are dried in a rotary dryer and sold as a stock food. The liquid is pumped to large lagoons, and that which has not percolated away is distributed on farm land.[P6]

DDT for Sewage Plants

DDT can be used in a number of ways for controlling flies at treatment plants. For general adult fly control, apply it on walls, ceilings, hanging objects, screen doors, etc.; also on fences, buildings and even vegetation around fly-breeding places. Use in the 5% solution with kerosene or ordinary fuel oil as the solvent. Apply with a clean paint brush or, on large surfaces, spray with a wet spray, not a mist, using about 1 quart of DDT solution to 250 sq. ft. of wall surface. With mosquitoes, the higher the temperature the greater the kill; but with the house fly, nearly twice as many will be killed by a given dose at 70° F. as at 100° F. Unfortunately, DDT is toxic to useful insects, such as honey bees. It does not affect the occasional user, but its cumulative effect may poison those continually using it over a long period if the oil is absorbed by the skin.[C23]

Don't!

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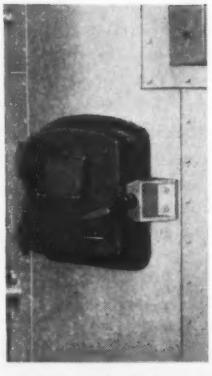

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3. Surface Disposal of Inland Oil Field Brines Conserves Fresh Water Supply. By Ogden S. Jones. Pp. 60-63.

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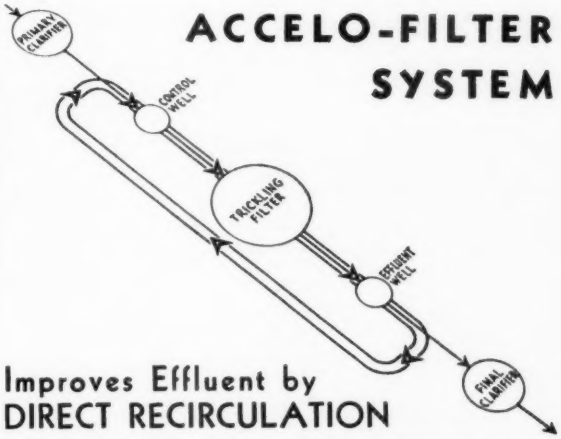

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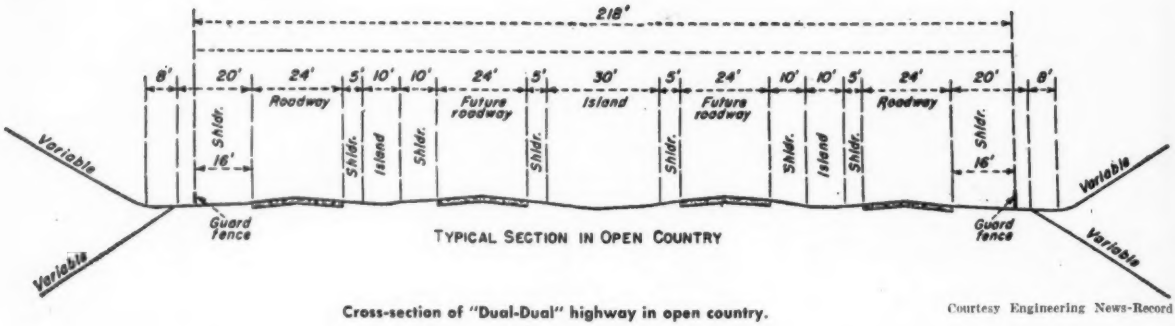

Cross-section of "Dual-Dual" highway in open country. Courtesy Engineering News-Record

New Jersey's Dual-Dual Highway

The average north-south traffic, excluding the purely local, in northern metropolitan New Jersey is about 160,000 vehicles per day, but the present state highways have satisfactory capacity for only 45,000. To relieve this deficiency the state has begun the construction of a highway consisting of four 24 ft. roadways of two lanes each. The outer pair of roadways will be for the slower speed and shorter haul traffic. In open country each road will have a 5 ft. shoulder on the left side and a 10 ft. on the right. Between the two north-bound roadways, and between the two southbound, will be a 10 ft. grass island; while between the two central express highways will be a 30 ft. grass island. These islands are depressed to receive drainage, and snow pushed from the roadways. Curve radii will generally range between 6,000 and 20,000 ft., with a minimum of 3,000. Grades have a maximum of 3%, desirable maximum of 2%, and minimum of 0.5%. Present plans contemplate a 10" reinforced concrete pavement, and paved shoulders capable of supporting trucks but having a rough surface which will discourage their use when not necessary. It is estimated that the 16.1 miles included in the first construction program will cost $44,000,000.[E12]

Responsibility for Sidewalk Defects

Courts have ruled that a municipality is liable for any damage due to failure to maintain its sidewalks in a reasonably safe condition, although most cities look to the abutting owners for sidewalk maintenance. To permit the city to recover from a property owner any judgment against it for such damages, Sweetwater, Texas, has passed an ordinance declaring it to be the obligation of owners, occupants and users of property to keep their sidewalks "at curb grade and level and free of depressions, excavations, elevations, inequalities, obstacles, obstructions or encroachments, natural or artificial, above or below ground level"; also free of oil, grease, ice, snow or water. If any injury or damage is occasioned by violation of the above, "primary liability shall rest upon the owner, occupant and user of the property abutting upon such defective sidewalk.[J3]

Constructing a London Airport

In constructing a 4500-acre airport at London, England, more mechanical equipment (most of it from the United States) is being used than has ever before been used in England. The subsoil is gravel, which furnishes an ideal sub-base when carefully compacted; but 70 acres are occupied by gravel pits, some of them 22 ft. deep, full of water and mud. These are being cleaned out and refilled with gravel, laid in 9" layers and compacted by sheepsfoot rolling followed by rubber-tired rolling. For several months a great deal of rain fell, and as the gravel could not be compacted when wet, the fill was made with lean concrete (14½ parts pit-run gravel to one part cement), power-rolled in 9" layers; water-cement ratio 0.6; 28-day compressive strength, 3500 psi.

The pavement, designed to take up to 100-ton aircraft, is 12", 4,000 psi concrete, with no reinforcing, laid in 20 ft. lanes, with 1" longitudinal expansion joints 60 ft. apart and transverse expansion joints at 120 ft. centers; and contraction joints at 20 ft. intervals. For forms, 8" steel forms bolted to 4" timbers, were used. Concrete was dumped by trucks onto the subgrade in 2.75 cu. yd. piles and spread by a powered blade type spreader, followed by a finishing and compacting machine provided with an eccentric cam type of vibrating beam, followed by a finishing screed; both machines new to England. Also new to England were the weigh-batching of aggregates; the close control of gradation by separation and batching of gravel in three sizes; and moisture determination by heat drying and weighing.[E9]

Destructor Clinker In Asphalt Roads

Clinker from the destructor of Fulham, England, was first used for constructing clinker-asphalt roads in 1911. Clinker is vesicular in character and highly absorbent. In even the finest grades it is angular and its coefficient of internal friction is very high when dry. It compacts 1/3 its depth when thoroughly rolled, which necessitates use of a heavy roller and an unyielding foundation. Then it does not distort easily, and waviness does not occur. It requires about 50% more asphalt than when stone is used instead of clinker. One-inch carpets laid on old pavement in 1931 are still in good condition. It is laid hot and rolled first with a light roller, then with a heavy one. The rolling can continue during light rains without detriment.[D7]

Vibratory and Impact Compaction

The soil mechanics laboratory at Princeton University has been carrying out an investigation for the Civil Aeronautics Administration concerning the effect of vibration on the bearing properties of soils. They studied the use of vibrated light-weight rollers and other vibratory equipment; impact equipment, sand piles, and vibro-flotators. The conclusions reached are that rollers of different types are likely to remain at present the most efficient type of compaction equipment for all cases where the fill can be placed and successively compacted in layers.

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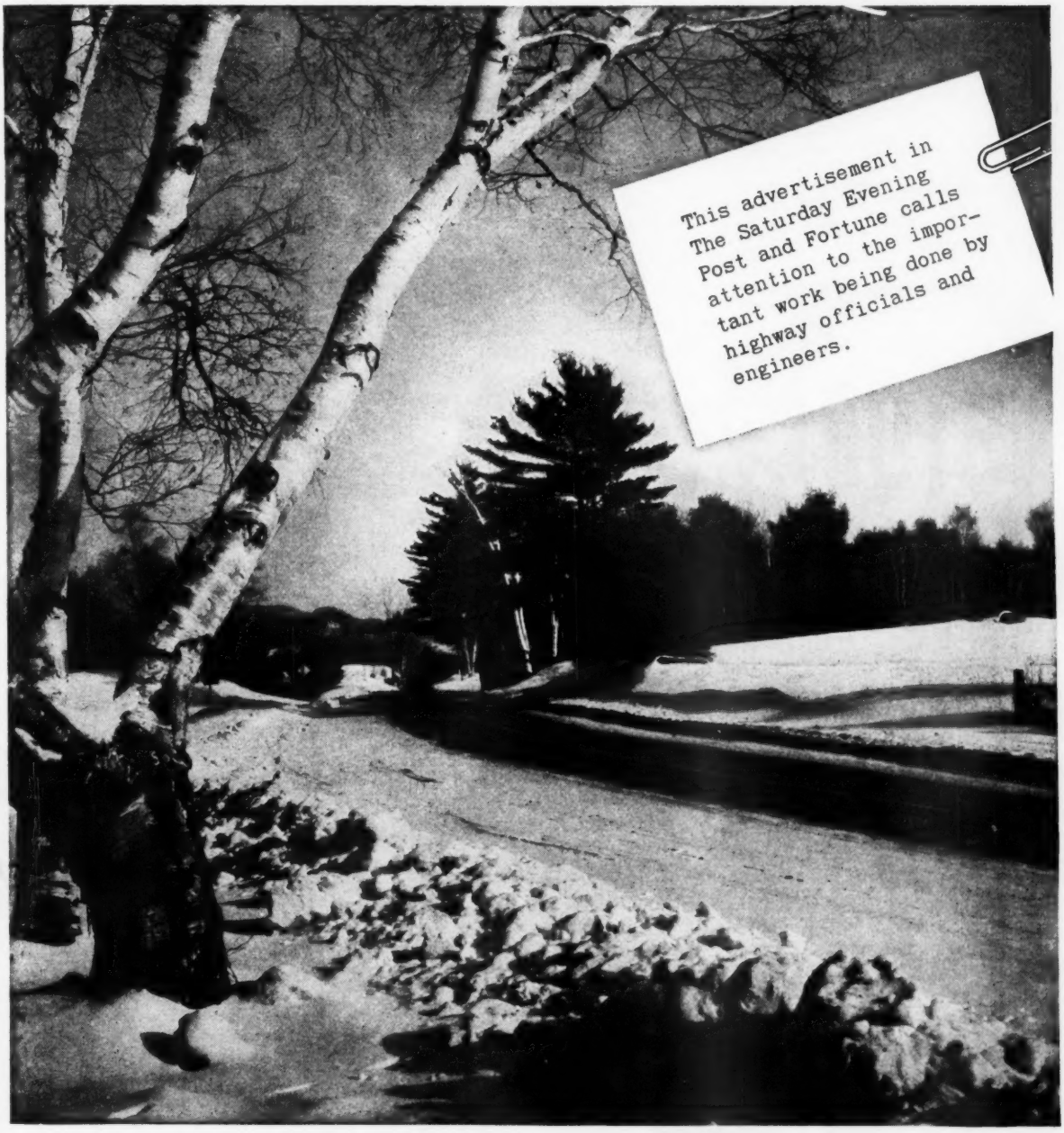

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For clay soils there definitely is no advantage in using vibratory soil-compaction equipment, but in certain cases there may be some advantage in using impact-producing types of such equipment.

The economic advantages of using vibratory or impact types of compaction equipment acting against the surface of a sand layer or deposit are not immediately apparent. The compaction of deep, loose, natural sandy deposits or of hydraulic fills beneath airports designed for planes of 50,000 lb. wheel load or more is a problem in a special category, for which use of a multiple sand-pile driver or multiple vibroflotator is suggested.[O3]

Access to Freeways

A decision of the Minnesota Supreme Court upholds the authority of the state highway commissioner to extinguish the right of access of property adjoining a highway. Said the court: "An abutting property owner's right of access to a public highway is an interest in land and an incident to the ownership thereof, subject to condemnation under the law of eminent domain, which may be taken thereunder for public use by the state in its sovereign capacity upon payment of proper compensation to the owner." Not a single authority has been cited which denies the state or its departments under the power of eminent domain the right to extinguish such easements on payment of just compensation.[E10]

Solving City Traffic Problems

Methods employed in attempts to solve the urban problem of city traffic include widening streets, limited access, elevated or depressed highways; belt lines to skirt the urban areas; and regulation of traffic. Until sufficient off-street parking areas can be provided, parking meters may help. Off-street parking areas cost $500 to $1,000 per vehicle space. Such facilities benefit, and should be paid for by, property and business in the central business districts, taxpayers in general, users of parking spaces, and the municipality itself.[P5]

Secondary Roads With Federal Aid

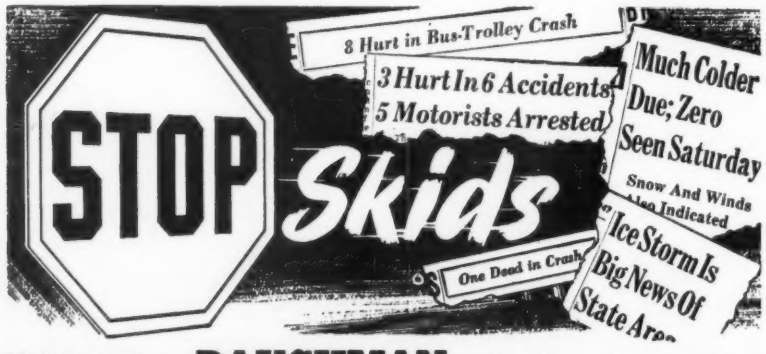
Widely varying policies and plans being followed by four of the states in carrying out the programs of improvement of secondary roads established in the federal highway act of 1944 are described in reports from Kansas, Texas, Alabama, and New York. The Kansas program involves county roads almost entirely. In Texas the program is a state one. Alabama's program is tied to a long-term program of state aid to counties, and provides for joint federal-state-county financing. In New York the program is partly a state and partly a county program.[R1]

Pollution Through Service Box

In Portland, Maine, water entering a residence in April, 1946, brought road tar with it through a copper service pipe laid in 1940. After investigating other possibilities, it was found that road tar had been spread on the street too abundantly and some had flowed down the curb box and formed a pool around the stop and waste. In November 1945 the house owner had closed his house and had the water shut off. This opened the waste in the stop, and tar entered it into the service pipe, and when the water was turned on in the spring the tar flavored and colored the water. If there had been polluted water in the gutter instead of tar, the consequence might have been serious.[V1]

Airport Fill On Soft Bottom

In expanding the San Francisco Municipal Airport, 6,000,000 cu. yd. of fill is being placed on a soft mud bottom reaching a depth of 80 ft. in places. Instead of excavating this mud before filling, it is pushed ahead of the fill in a wave. The depositing of the fill is carefully regulated so as to keep the wave in continuous motion along the entire front, leaving no pockets of mud under the fill. At the same time, water is squeezed out of the mud that is not moved ahead. The fill is first brought up to El. + 8.0 or 8.5. The heavy earth-



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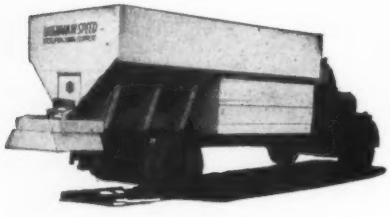

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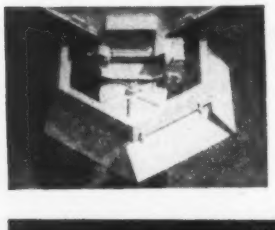

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moving equipment (33-yd. to 13-yd. bottom dump types) compacted this to 90% of standard density. On this, 30" of fill was compacted to 95% by use of sheepsfoot rollers. The fill material was brought 3 miles over a haul road covered with 3" of asphalt on 6" of rock that cost $500,000. About 75 earth-moving machines hauled an average of 20 loads per shift.

Drainage presented a difficult problem, as some of the aprons and taxiways are as low as El. 7.0 and the highest point is 13.0, while the tide range is from El. — 2.0 to + 9.4. The field is drained by two methods: One employs ponds between runways which are drained by pipelines with flap valve outlets at El. + 6.0. The other method is the usual system of underground drain pipes. Drainage design is based on a 100-yr. rainfall record of 0.5" per hr. for 5 hours.[E11]

Cost of Construction

It is conservatively estimated that the cost of highway construction now is 50 to 55% above 1940 prices, and is 15 to 20% above those of January 1946. Labor is blamed chiefly for the increase, as much because of less efficiency as of increased wages. Least increase is found in work employing a maximum of mechanical equipment and improved techniques, notably earth excavation, cement concrete and bituminous concrete. State highway departments have minimized increases in cost by eliminating refinements, grouping several small projects into one contract, letting contracts in the fall for next season's work, and in other ways helping the contractors to reduce costs. Many low bids were rejected and the work re-advertised — 30% by dollar volume in Illinois. Many believe that the peak of costs has been reached.[E15]

Paving Blue Ridge Parkway

Construction of the Blue Ridge Parkway, 477 miles long, was begun in 1935 and 171 miles have been completed and 28 are being paved. In constructing it, the grading and an 8" stone base are completed and used by traffic for at least a year, then paved with asphalt. The first stretches of paving were road mix, but experience has shown that plant mix asphaltic concrete gives a tighter pavement, and one more economical when maintenance over a period of years is considered.

The 8" base is laid in three equal layers, each compacted with smooth steel rollers. The asphalt is mixed at the nearest railroad siding, but this gives a maximum haul of nearly 30 miles, and because of this and cool temperature due to the high altitude, cold laid concrete was used. The present program calls for 250 lb. per sq. yd. prepared to type H-1 standards of the P R A, 160 to 170 lb. as the first course and 80 to 90 lb. as wearing course. Both are made with limestone aggregate, as the other local stone contained mica, to which the bitumen does not bond well. The top course is covered with 3 to 4 lb. per sq. yd. of a dressing consisting of mineral dust, screenings or sand mixed with RC-2 or 3 asphalt and liquefier. The pavement is 20 ft. wide, plus widening on curves; 8% maximum grade; 150 ft. maximum radius of curvature for inside curves and 200 ft. for outside; 2" crown on tangents; 5 ft. minimum shoulder width.[E6]

Maine's Turnpike

Maine has begun construction of a 4-lane dual super-highway that will be operated as a toll highway by a "Turnpike Authority." It will extend from Kittery on the Massachusetts border to the Canadian border. The southern 44 miles is now under construction by two contractors for grading, two for the 40 bridges and grade separation structures, and one contractor for the paving.

Because of snow, embankments are preferred to cuts. The maximum curvature is 1°; maximum gradient not over 4%. Vertical sight distance 525 ft. A frost-free subgrade is provided consisting of 2 to 4 ft. of granular material containing not more than 10% of fines passing a 200 mesh screen. There are

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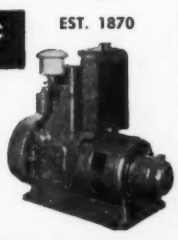

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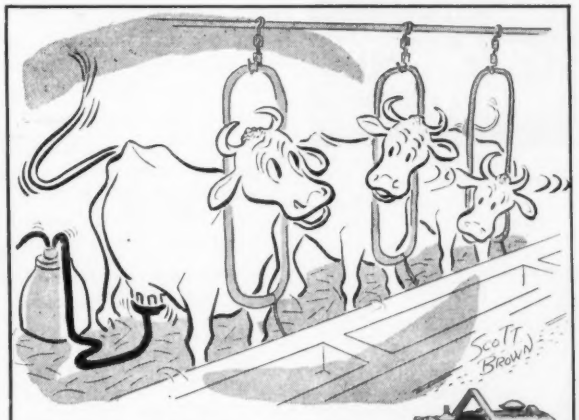

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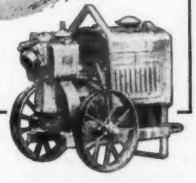

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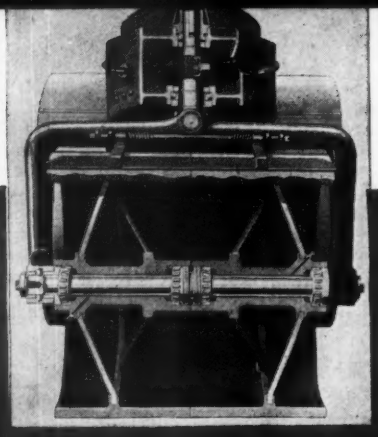

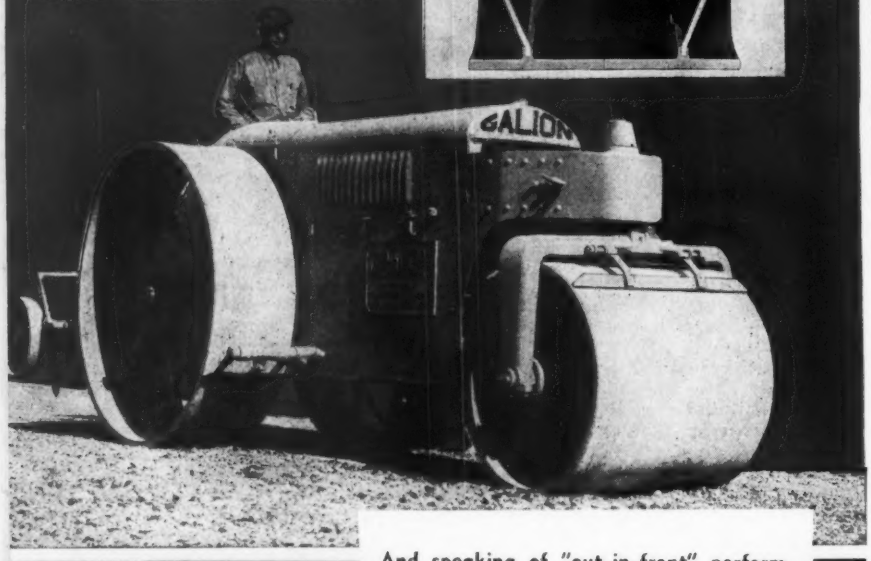

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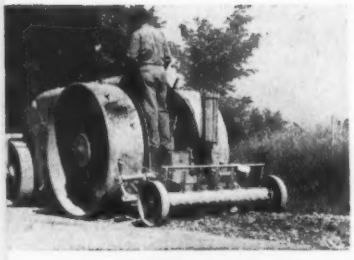

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two 24 ft. lanes in each direction, separated by a 26 ft. median strip, and having a 4 ft. shoulder on one side and an 8 ft. on the other paved with asphalt-surfaced gravel. The turnpike pavement will be 8" of asphaltic concrete, hot mix.[E16]

Texas Land Service Roads

During 1946 Texas placed under contract 2,060 miles of "land-service" (secondary) roads, to cost $19,658,000. Ultimately the state will improve 7,500 miles of such roads. It aims to provide highways that will give useful service for at least 15 yr. at minimum cost of construction and maintenance. Pavement widths are generally 18 or 20 ft.; 16 ft. if carrying less than 100 vehicles a day. On 4" to 6" stabilized base courses are placed a dustless all-weather asphalt surface, generally application of 0.3 to 0.5 gal. per sq. yd. of liquid asphalt, blading and rolling, followed by 1 to 2 cu. yd. of gravel or stone chips per 120 sq. yd. of surface. If the traffic is relatively heavy, a second similar coat is applied.[E13]

Reinforcement and Cracks in Concrete

Surveys made annually for 22 years of Rhode Island's 545 slab-miles of concrete pavements has led to the conclusion that distributed reinforcement effectively controls the amount of cracking and minimizes the number of cracks over areas in which plain concrete might be expected to exhibit excessive cracking. In general, cracking is most likely to occur over culverts and bridges, at ledge locations, at intersections of cut and fill, at or near manholes and water gates, and where new pavement is placed directly over existing water-bound macadam (probably due to improper drainage) and over heavy fills, particularly in swampy locations.[E5]

China's Highways

China's ancient roads were built for rustic vehicles drawn by men or animals. Its first modern road was built in 1913. A National Economic Council, established in 1932, adopted a central-aid road system and a program of territorial expansion road construction, and promoted road building in districts where traffic is insignificant. By the end of 1943 the total length of highways open to traffic was 34,000 miles. The present National Highway Administration was founded in 1943, and has fixed engineering standards for highway construction and adopted a 10-yr. postwar plan of highway construction which includes 157,000 miles of new roads and improving 74,500 miles of existing roads. China does not have enough trained technicians, facilities or financial resources to carry out this plan, and solicits technical and financial help from the allied nations.[R]

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8. Highway Engineering in 1946. Pp. 21-24.

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9. Highway Bridges in 1946. Pp. 37-38.

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10. Some Economic Aspects of an Improved Road System. By Christopher T. Brunner. Pp. 63-65.

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13. Texas 1946 Secondary Road Program Establishes New Construction Record. Pp. 99-102.
14. New York State Builds Its Thruway. By Thomas F. Farrell. Pp. 103-107.
15. Have Highway Costs Reached Their Peak? Illinois, 109-110. Texas, 110-111. Pennsylvania, 111-112. Georgia, 112-114. Oregon, 114-115. California, 115-117. Louisiana, 117-118. Virginia, 118. Michigan, 118-119. No. Dakota, 119-120.
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21. Dangers of Highway Bankruptcy. By R. H. Baldock. P. 84.

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4. Connecticut Applies Aerial Mapping to Urban Highway Planning. By Wm. J. Cox. Pp. 82-85.
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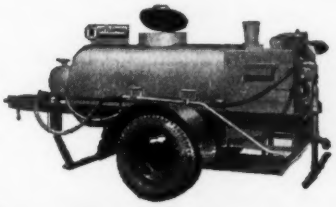

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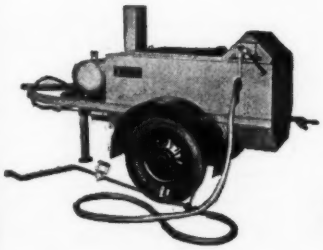

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Pittsburgh-Empire *compound water meters* are illustrated, described and specifications given in a new booklet (W-803) by Pittsburgh Equitable Meter Division, 400 N. Lexington Ave., Pittsburgh, Pa.

Disc Water Meters.—The Arctic disc meter is described in a new bulletin, which includes a 3-page section on repair parts. All sorts of handy views and sections to clarify the workings of the meter. Covers ⅝, ¾ and 1-inch meters. Pittsburgh Equitable Meter Division, 400 No. Lexington Ave., Pittsburgh 8, Pa.

Rotameters. — Rotameters designed for severe high temperatures and high-pressure operation are described in Bulletin 43-E, which includes many illustrations and descriptive material. Fischer & Porter Co., Hatboro, Pa.

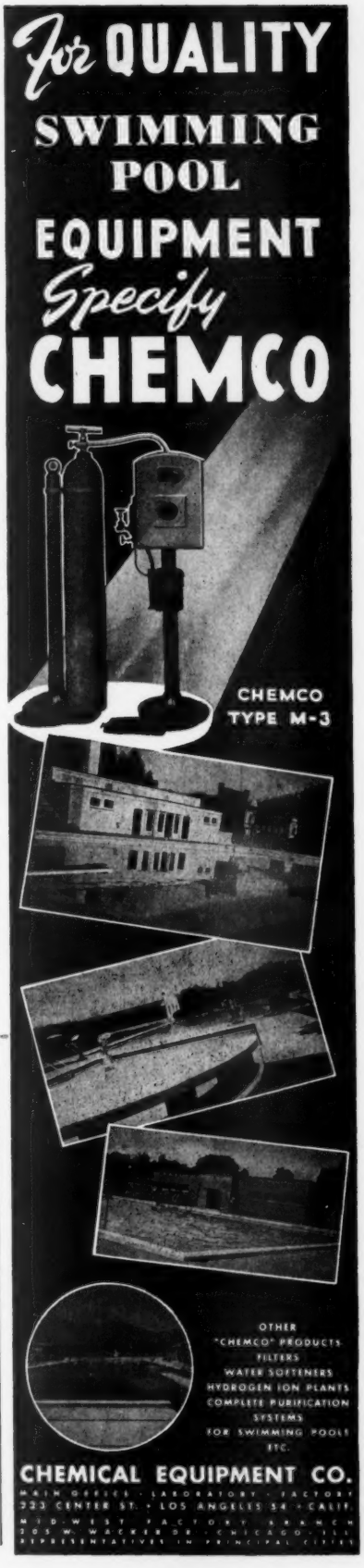
Remote Controls.—Remote indicating and control systems—what they are and what they are capable of accomplishing—are explained in a 12-page engineering bulletin. Allis-Chalmers Mfg. Co., Milwaukee 1, Wisc.

Jacks.—A new 40-page catalog contains much information on Duff-Norton jacks, including ratchet, screw, air-motor operated and hydraulic jacks; also automatic lowering mechanisms. Catalog gives application data and illustrations. Ask for Catalog 203. Duff-Norton Mfg. Co., Box 1889, Pittsburgh 30, Pa.

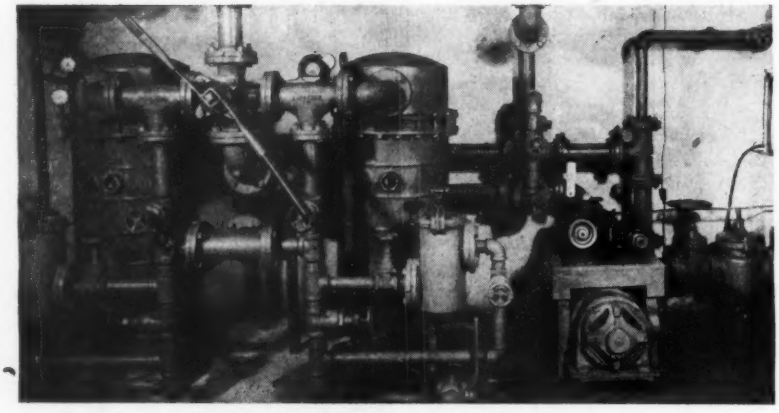
Four Wheel Drive Trucks.—An 8-page folder illustrating the F W D 5-ton trucks, and the uses for which it is designed. Four Wheel Drive Auto Co., Clintonville, Wisc.

Fans for Corrosive Fumes.—A 12-page bulletin by Duriron Co., Inc., Dayton, O., gives complete engineering data on corrosion-resistant fans for exhausting acid and other corrosive fumes; also information on types of drives, hood outlets, etc.

Water Conditioning Chemicals and Equipment. — A 12-page instruction booklet by Allis-Chalmers Mfg. Co., Milwaukee, Wisc. This booklet refers principally to conditioning of feedwater for power plant equipment.



PUBLIC WORKS Equipment News



Two diatomite filters installed at a swimming pool.

"Pur-O-Cel" Pressure Filter

The "Pur-O-Cel" water filter, designed for small water treatment plants and swimming pools, makes filtering a simple, mechanical operation. This filter utilizes thin mats of diatomaceous earth, producing clear, brilliant water. It removes amoebic dysentery cysts and many bacteria. Due to the rapid filtration rate the "Pur-O-Cel" filter is smaller than a sand filter of the same capacity and thereby saves floor space. Back-washing of the filter for cleaning is accomplished without disassembling the unit and with a comparatively small volume of water. Write Proportioneers, Inc., 96 Codding St., Providence 1, R. I. for bulletin 1550 describing this unit in detail. *(Add to Chapter 7, Water Works Manual)*

Testing Screen Eliminates Hand Work

The Gilson mechanical testing screen has been developed for efficient sizing of test samples of crushed stone, gravel, slag and similar materials by Gilson Screen Company, Mercer, Pa. To meet the current demand for controlled and truly guaranteed aggregates and concrete products it provides a rapid and practical testing method which will be of interest to those who are not satisfied with laborious and inconsistent hand methods.

This screen handles up to one cubic foot of sample, making from two to seven separations simultaneously. Screen action is so adjusted, it is claimed, that separation approaches the theoretical refusal point very closely even when samples contain elongated fragments and materials varying in density. Very fine materials can also be handled efficiently and the screen has been found useful for concrete research and other special applications where extremely close sizing is desirable.

The Gilson testing screen.

Also available is a sand attachment which uses standard eight-inch diameter testing sieves in conjunction with the vibrating unit. This attachment is optional and can be inserted in any Gilson testing screen or removed in a few seconds with only two manual operations. The testing screen is efficient over the entire size range from 4-inch to 200-mesh which, according to the manufacturer, has not previously been accomplished with this type of equipment. For a descriptive bulletin with many interesting details, write the manufacturer.

Small Tournapull for County, Municipal and Governmental Uses

A small Tournapull for high-speed dirtmoving, the 85 HP Model D, has been developed by R. G. LeTourneau, Inc., Peoria, Illinois. Equipped with a Carryall scraper having a load limit of 4 tons, this small highspeed unit is especially suited for county, municipal and governmental use. One feature of this Tournapull is control by individual electric motors which replaces conventional steering and gear shift levers and eliminates the need of a power control unit for scraper operation.

It is claimed that under average conditions a single D Tournapull, self-loading and one-man operated, is capable of moving 48 yards an hour on 200' one-way haul. LeTourneau states that one of these small Tournapulls can operate successfully all by itself, and that its production capacity, speed and mobility make it especially versatile for handling light cut and fill work, road maintenance, working roadside gravel pits, hauling and spreading

LeTourneau small scraper.

ONE TYPE OF BODY IS NOT ENOUGH-

Pictured is the Apartment-type body in three stages of operation. Above, on ground. Below, in carrying position. Right, dumping.

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If rubbish collection is a "Headache" in your community, if you use the old fashioned, unsanitary open truck method of collection, it will pay you to investigate the Dempster-Dumpster System. Here's how it works. A large number of bodies, each designed for the specific needs of the user, are placed at needed points for community projects, schools, apartments, factories and stores. They are picked up loaded, at regular intervals in a few seconds by truck hoisting unit for hauling and dumping. It's as simple as that. One man can handle the entire operation. It eliminates costly injuries to personnel, and unsanitary litter in your city's streets. The Dempster-Dumpster system is flexible, and adaptable to the smallest or largest community. Equipment investment and maintenance is at a minimum and will easily fit into your municipal budget.

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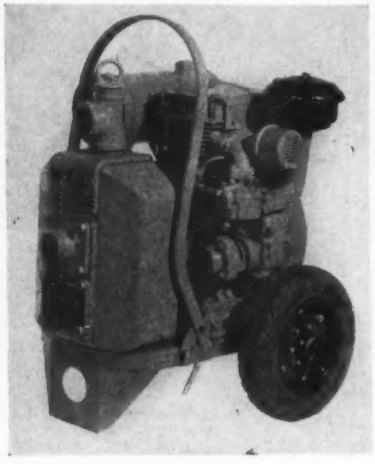
surfacing materials, airport maintenance and drainage, correcting erosion damage, building small dams and ponds for irrigation, and as a one-man utility dirtmoving tool on any small yardage project. *(Add to Chapter 1, Highway & Airport Manual)*

Rex Press-Formed Centrifugal Pumps

A new construction feature is found in the line of self-priming centrifugal pumps recently announced by Chain



Rex pump.

Belt Company of Milwaukee. The pump body is press-formed from Armco Ingot Iron, resulting, it is claimed, in saving in weight and increased resistance to corrosion or cracking due to freezing or impact, while the smooth surface of the pump and press-formed volute improves pumping efficiency.

FOR SALE

NW—80D Shovel and Drag
NW—6 Shovel and Drag
NW—95 Dragline Diesel
Insley K-12 ½ Crane and Backhoe
B-E 10-B Shovel
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Cleveland Model 110
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Cat. D-4 Angledozer #2T4259
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D-6, 7, 8 Bulldozer

*Inquire about our finance plan.

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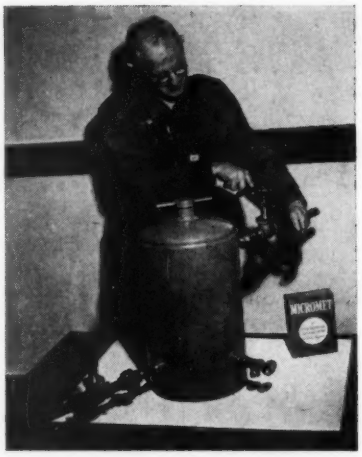

Commercial size Micromet feeder.

Corrosion and Scale Correction

For a commercial, institutional or industrial establishment having corrosion or scale water troubles in hot water or cooling water systems, Calgon, Inc., of Pittsburgh has developed a new series of Micromet feeders, a modification of Calgon, which is used in more than 600 municipal water systems.

The feeders are like those developed last year for domestic use, but larger holding up to 20, 50 or 100 pounds of Micromet at one charge. For corrosion the 50-pound feeder will handle up to 150,000 gallons of water per month. For hard waters producing lime scale it will handle up to 300,000 gallons. The larger feeder will handle up to 1,000,000 gallons of scale-producing water per month. The smaller type feeders will handle as low as 3,000 gallons per month. *Add to Chap. 6, Water Works Manual.*

Waste Line Cleaning

The "Electric Eel," a power operated waste line cleaning machine, features a double cable for prevention of injury in case of breakage. The machine illustrated cleans lines up to 6" and may be equipped with trap knives or double edge tools which will cut roots quickly as well as clean lines. Cable is easily retrieved in case of breakage inside of drains, as both outer shield and cable are integral. Bulletin available from Ohio Tool & Engineering Co., Box MS-46, Springfield, Ohio. *(Add to Chapter 11, Sewerage Manual)*

The "Electric Eel."

Air-Cushion Clutch for Power Shovels

The several motions of power shovels, hoisting, crowding and swinging, are all powered by the same engine, and in each case the shovel has to pick up the load while the clutch shaft is turning at full speed. Air controls have been developed by engineers of the Osgood Company, Marion, Ohio, using the "air-cushion" clutch which is engaged by admitting air to a circular rubber tube. This tube, expanding between a fixed and movable plate, clamps the friction disc between the movable plate and the back plate of the clutch. Metering the air supply controls the speed at which the clutch is engaged; the volume of air required making it impossible to jerk the machine. In addition, this type of construction eliminates wear and lost motion of the small parts found in conventional clutches, and expansion of the tube automatically adjusts for wear on the friction disc. *(Add to Chapter 1, Highway Manual)*

Oozer Hose for Concrete Curing

The long-time method of using straw saturated with water to wet down concrete during the hardening or "curing" period may be headed for the discard, according to The B. F. Goodrich Company, Akron, Ohio.

Goodrich Oozer hose.

The company reports that one of the large New England contractors has been handling this phase of the concrete operations by using Oozer hose, from which the water seeps gently and continuously. The hose is made of special fabric and had previously found wide application on lawns and in gardens. *Add to Chap. 4, Highway and Airport Manual.*

The "Quinn Standard"

FOR CONCRETE PIPE

The Quinn Standard is known as the best the world over, wherever concrete pipe is producd and used. Backed by over 30 years' service in the hands of hundreds of Quinn-educated contractors, municipal departments and pipe manufacturers who know from experience that *Quinn pipe forms* and *Quinn mixing formulas* combine to produce the finest concrete pipe at lowest cost.

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For making pipe by hand methods by either the wet or semi-dry processes. Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe—any length.

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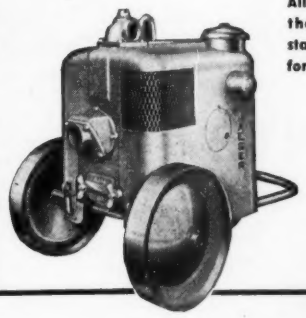
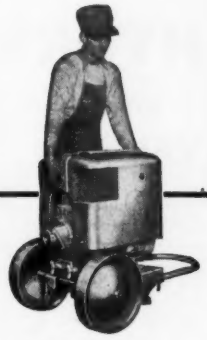


All-weather enclosures keep them clean, dry, quicker-starting, smoother running — for the life of the pump.



Extra powered, conservatively rated and faster and doubly-sure to prime, a Jaeger is a more efficient pump to start with and maintains that high efficiency for longer years of life. Sizes to 10". Send for Catalog P-45.

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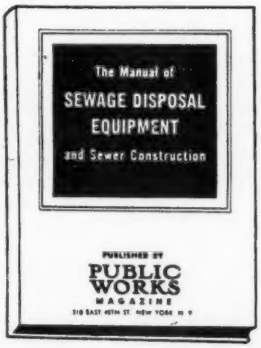

A great help in working up plans for sewage disposal

The new 1946-47 edition of The Sewerage Manual is now off the press. This new Manual describes every type of equipment and material available for use in sewage disposal and sewer construction. It is used by leading sanitary engineers everywhere when preparing plans. It is the standard source of unbiased information.

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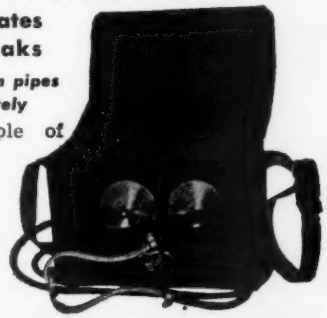

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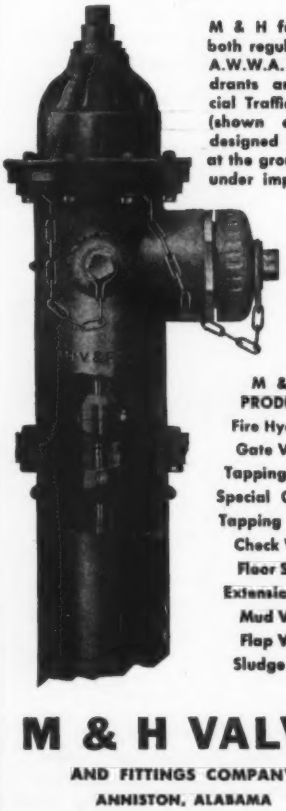

M & H furnishes both regular type A.W.W.A. fire hydrants and special Traffic Model (shown at left) designed to yield at the ground line under impact.

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Fire Hydrants
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Floor Stands
Extension Stems
Mud Valves
Flap Valves
Sludge Shoes

M & H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

Trickling Filter Design

(Continued from page 36)

tal pressure of the filter stone is exerted against the ends of the tile blocks only, while the stone that slopes into the ends of the tile adds stability. However, such walls should be analyzed for stability in all cases.

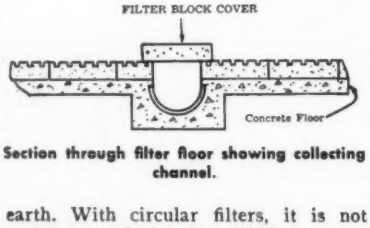
Wall Thickness and Section

A concrete wall for a filter is usually 8″ to 12″ thick, depending on height; surcharge if any; and on the practice of the designer. With a circular wall designed on the cylinder formula, $S = pR$ where S is the unit stress, p the internal pressure and R the radius of the cylinder. A straight wall is designed as a retaining wall and should be stable against any normal overturning force—stone pressure within and no earth backing; hydrostatic pressure, if the wall is tight, with no earth backing and earth pressure from without with no stone in the filter. Generally a reinforced wall is preferable to a gravity section.

Low freebords permit wind to interfere with distribution of sewage to the bed; high freeboards protect against the wind but permit or encourage deposits of leaves or drifting of snow and formation of ice on the walls, which will stop rotary distributors. Most distributors are set fairly close to the stone surface, and are not much affected by normal wind action. A freeboard of 6 to 9 ins. is common for rotary distributors and 12 ins. for spray nozzles.

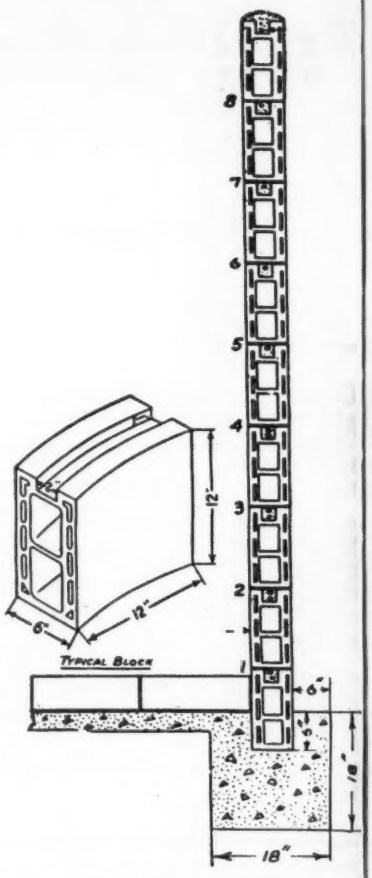
Design for Stability

On straight walls, as for rectangular filters, stability is computed as for retaining walls. A value of 45° for the angle of repose for broken stone can usually be adopted, though a safer design value would be 1 to 1½, or 33°41′. The weight of crushed stone can be determined locally; usually it will not exceed 100 lbs. per cu. ft. It is best to assume 115 to 125 lbs. per cu. ft. for the possible weight of wet backfill. Allowance should be made for surcharge, if there is any. For a water tight wall, calculate for hydrostatic pressure with the filter full to the top of the wall. The pressure on this basis will exceed that for either stone or



Section through filter floor showing collecting channel.

earth. With circular filters, it is not necessary to design for stability against overturning if circumferential reinforcing is carried entirely around the unit with proper lapping. However, the wall



Filter wall constructed of reinforced tile block segments.

should be anchored to or inset into the base.

A filter should not be placed part in cut and part on fill. If absolutely necessary, footings should be extended into firm original soil and the filled area inside of the filter compacted thoroughly using selected soil.

Reference

[2]Statement of Jan. 31, 1944, superseding previous joint statement of policy.

The third installment in this series, covering low rate filters, will appear in the April issue.

Le Roi Buys Cleveland Rock Drill Company

Le Roi Company, Milwaukee, Wisconsin, manufacturers of internal combustion engines, portable compressors, engine-generator sets and mowing equipment, announces the purchase of the Cleveland Rock Drill Company of Cleveland, Ohio. Russ Morgan, formerly secretary and sales manager of The Cleveland Rock Drill Company, will head the new organization. Le Roi-Cleveland products include a complete series of rock drills, a wide range of paving breaker models, two types of spaders, a back fill tamper and related accessories.

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70. Useful new 60 page catalog on standard corrugated pipe, multi-plate pipe and arches and 18 other drainage and related products for culverts, sewers, subdrains, flood control, airports, water supply and other types of construction. Ask for "Armco Products for Engineering Construction," Armco Drainage and Metal Products, Inc., Dept. PW Middletown, Ohio.

Improve Appearance of Curbs, Gutters, Sidewalks

78. Curb and Gutter and Sidewalk Forms, including battered face curb form specially for modern traffic conditions. Last 20 years or more. Send for new engineering data Bulletin A-20-F, Dept. P.W., Heltzel Steel Form & Iron Co., Warren, O.

Handle All Kinds of Tough Grading Jobs Economically

98. The Austin-Western 99M Power Grader with its powerful all wheel drive handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow ploughing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946, Dept. P.W., Austin-Western Co., Aurora, Ill.

One Man Operates This Self-Contained Gas Hammer

110. Powerful self-contained gasoline hammers illustrated in new booklet. Used as paving breakers and spike drivers. Easily portable, economical. Write Syntron Co., 660 Lexington, Homer City, Pa.

Methods of Installing Steel Sheet Piling

112. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maximum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., Dept. P.W., 1820 N. Central Ave., Chicago 39, Ill.

Reliable Every Purpose Pumps

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

Got an Earth Moving Problem?

126. Write Gar Wood Industries, Dept. P.W., Wayne, Mich., on their Two and Four Wheel Scrapers, Bulldozers, Tamping Rollers, Winches, Hoists and Repair Towers.

"Dieselectric" Plants for Low-Cost Light and Power

392. 20-page catalog P.W. describes "Dieselectric" plants 3 to 10 KVA, and diesel engines from 4 to 12 H.P. These are easily transported and will produce reliable, low cost light and power anywhere. Write WITTE ENGINE WORKS, Division of Oil Well Supply Company, Kansas City 3, Mo.

Single Unit Impact Breaker and Pulverizer Has No Gadgets

521. Breaks stone into cubical shapes, can be used as pulverizer, too. Simple design. Gives years of service. Light weight and strong. Get new bulletin PW today. The Eagle Crusher Co., Inc., Galion, Ohio.

The 32 Basic Advancements in the New Ford Trucks

522. Beautiful new catalog explains the 32 basic advancements of the new Ford trucks. Gives engine specifications. 138 pictures show special features of engines, chassis and some body models. Send for your copy. Truck and Fleet Sales Dept., Ford Motor Company, Dearborn, Mich.

One to Two H.P. Air Cooled Engine for Dependable Power

523. New bulletin illustrates many uses for Clinton 1 to 2 H.P. gasoline engines. Gives full specifications and power data. An economical, long lasting power unit. Write Dept. PW, Clinton Machine Co., Clinton, Mich.

Briggs and Stratton 4-Cycle Air Cooled Engines

524. Tested under severest conditions of long, hard use, these engines have earned world wide recognition as the "night" power for hundreds of applications. Get latest bulletin from Dept. PW, Briggs and Stratton Corp., Milwaukee 1, Wisc.

Stationary Power Units for Power, Economy and Efficiency

530. Data sheets and specifications give full details of Minneapolis-Moline Power Units in sizes from 26 HP to 88 HP burning gasoline and 88 HP burning butane gas. Write Dept. PW, Minneapolis-Moline Power Implement Co., Minneapolis 1, Minn.

Want Water Tight Walls and Floors?

531. How to secure this dry and desirable condition by using Stonhard STONITE is the subject of an interesting free folder. Use our coupon or write Dept. PW, Stonhard Co., 883 Terminal Commerce Bldg., Philadelphia 8, Pa.

SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

Fast, Efficient Skid-Proofing

355. Get full facts about Baughman Light-Weight Cinder Spreaders, fast operators for cinders, sand, salt, chips, etc. Free flowing at low temperatures. 9-17 cu. yd. cap. Write Dept. P.W., Baughman Mfg. Co., Inc., Jerseyville, Ill.

STREETS AND HIGHWAYS

Expansion Joint Fillers for Highways, Dams, Bridges, Etc.

102. Kork-Pak fiber joint, Premoulded Asphalt Joint, Non-Extruding Cork Joint, Self Expanding Joint for use on Highways, Dams, Bridges, Tunnels and General Construction. Bulletin describing and illustrating these joints sent on request to Servicised Products Corp., 6051 West 65th St., Chicago 38, Ill.

Levels Sidewalks and Curbs Quickly and Easily

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee 10, Wis.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Strong, Speedy, Low-Cost Maintainer Has Many Uses

130. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Full details in illustrated folder. Huber Mfg. Co., Dept. P.W., Marion, Ohio.

Tandem, 3 Wheel and 3 Axle Road Rollers

138. "The Buffalo-Springfield" line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog P.W. issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

Looking Into Soil Stabilization?

154. "Soil Stabilization with Tarvia"—An illustrated booklet describing the steps in the stabilization of roadway soil with Tarvia will be mailed on request by Dept. P.W., The Barrett Division, 40 Rector St., New York 6, N. Y.

Mix-in Place Roadbuilders Save on Scarce Labor

187. Mix-in Place Roadbuilders. Bituminous Pavers, Concrete Bituminous Fin-

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ishers. Adjustable Spreaders, Forms, etc. —4 complete catalogs in one cover, issued by the Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Latest Maintenance Equipment For Blacktop Roads

290. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

Special Truck Bodies for Every Municipal Need

375. Gar Wood special bodies for sanitary refuse collection are illustrated and described in a new catalog issued by Gar Wood Industries. Dept. P.W., Wayne, Mich.

Mow Clean and Fast In Tight Corners

510. Send for latest literature about the Cunningham Mower for Fence Rows, Parking Areas, Driveways, Picnic Grounds and many other jobs. 3 ft. cut, variable speed, rugged, easy to handle. James Cunningham, Son & Co., Dept. 16, 13 Canal St., Rochester 8, N. Y.

Widens Roads 2 to 8 Ft. Quickly, Economically

520. Apsco Road Widener handles every bituminous mix and any combination of aggregate. Two men and Apsco can lay 150 tons of mix an hour making smooth, finished surface. Get full details from Dept. PW, All Purpose Spreader Co., Fuller Road, Elyria, Ohio.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Valuable Booklet on Porous Diffuser Plates and Tubes

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability, 20 pp. illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

It's No Trick to Clean Sewers This Modern Way

386. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

All About Flow Meters

409. The primary devices for flow measurement—the orifice, the pitot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (No. 300). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia 42, Pa

PLAN on using COPPERSETTERS

Meter mountings tailor-made to your requirements in height, type of piping connection and size. Can be furnished plain or with inverted-key angle valve alongside meter.

Write for further information.

The FORD METER BOX COMPANY, INC.
Wabash, Indiana

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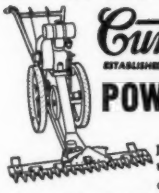

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JAMES CUNNINGHAM, SON & CO.
13 CANAL ST., ROCHESTER 8, N. Y.

USE COUPON ON PAGE 69

ow to Combat Corrosion n Your Gas Holder

41[illegible] A 16-page bulletin gives detailed information on the development of corrosion—and how to combat it—in gas holders. A copy will be mailed on request to The Stacey Bros. Gas Construction Company, 5535 Vine St., Cincinnati 16, Ohio.

ake Low-Cost Electricity rom Cheap Fuel

422. New booklet describes Sheppard Diesel Generating Sets that make low cost electricity from cheap fuel and give dependable service in the hands of any average operator. Write R. H. Sheppard Co., 50 Middle St., Hanover, Pa.

ow to Select ain Line Meters

432. New bulletin illustrates Builders Air Relay system for liquids containing suspended solids like sewage. Eliminates corrosion, clogged pipes, etc. "The Selection of Main Line Meters," a highly informative and useful presentation, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., Dept. P.W., 9 Codding St., Providence 1, R. I.

ow to Make Better ewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

ave Trucks and Labor n City Rubbish Collection

459. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolector described in literature just published by Dempster Brothers, Inc., 996 Higgins, Knoxville 17, Tenn.

ow to Get Automatic emoval of Screenings

460. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and inclined types). Link-Belt Co., Dept. P.W., 2045 W. Hunting Park Ave., Philadelphia 40, Pa.

n Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

ow Nichols Incinerator isposes of Sewage Solids

464. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes—a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Dept. PW, Nichols Engineering and Research Corp., 60 Wall Tower, New York 5, N. Y.

sk for This Design Data n Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

seful Design Data on edimentation Tanks

482. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, Dept. P.W., 570 Lexington Ave., New York 22, N. Y.

ackaged Sewage Treatment— ust Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Look Into This Sewage Treatment Equipment

490. New bulletin P.W. fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Dept. P.W., Hardinge Company, Inc., York, Pa.

Need Equipment for Small Sewage Plant?

491. Small type Conveyor Sludge Collector and Skimmer, Grit Collector, Aero-Filter and other equipment for small sewage treatment plants are described and illustrated in bulletins from Chain-Belt Co., 1722 West Bruce St., Milwaukee 4, Wis.

Glazed Clay Blocks for Trickling Filter Underdrains

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National Fireproofing Corp., Pittsburg 12, Pa., for free copy.

Engineering Details of Armcre Filter Blocks

525. Engineering bulletin shows construction details of Armcre Filter Bottom Blocks for better trickling filter results. Tells how Armcre blocks meet all requirements. Write to Ayer-McCarel-Reagan Clay Co., Brazil, Ind.

For Completely Successful Trickling Filter Systems

526. Armcre Filter Bottom Blocks by BOSCO. 12-page illustrated booklet explains how Armcre blocks meet every requirement for successful trickling filter operation. Gives full specifications and construction details. Includes use for Bio-Filtration. Write Bowerston Shale Co., Bowerston, Ohio.

One-Unit and Two-Unit Vitrified Floor Systems

527. Metro one-unit and two-unit vitrified clay blocks for trickling filter floors are described in illustrated catalog. Includes construction drawings, pictures and complete specifications. Ask for your copy today. The Metropolitan Paving Brick Co., Canton, Ohio.

All About Translot Filter Bottom Blocks

528. Illustrated Engineering Bulletin gives full data about Translot Filter Blocks for Trickling Filters. Shows typical sections, installation views, etc. Write Cannelton Sewer Pipe Co., Cannelton, Ind.

For All Sludge Dewatering

601. The first filters to be used in large scale operation on primary, elutriated and Guggenheim sludges. Ask for latest engineering Bulletin P.W. General American Process Equipment Div., 10 E. 49th St., New York, N. Y.

Low Cost Air for Sewage Disposal

602. All interested in low cost air for sewage disposal will want a copy of this useful booklet. Describes operating principles and specifications of Roots-Connersville Aerating Blowers. Write to Roots-Connersville Blower Corp., 301 Valley Ave., Connersville, Ind.

WATER WORKS

How to Analyze Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., Dept. P.W., 40 Rector St., New York 6, N. Y.

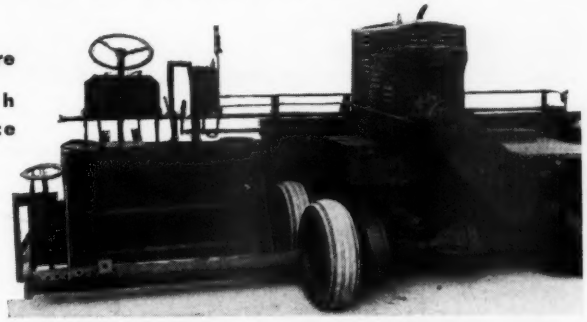
Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing ad-

Widen Your Roads 2 to 8 Feet Quickly and Economically

Operates Anywhere

Makes Smooth Finished Surface



Apsco Road Widener or Trench Filler Handles Any Material

THE Apsco Road Widener lets any highway department widen present roads for better service and safer driving—without prohibitive cost.

Lays 150 Tons an Hour

The Apsco Road Widener handles every bituminous mix in any combination of aggregates quickly and very efficiently to widen roads 2 to 8 feet.

Fills any depth in one pass. Two men and an Apsco road widener can lay 150 tons of bituminous mix per hour. Material is augered into strike-off box, then deposited in the trench. Strike-off blade makes a smooth-finished surface. Newly laid road strip will be as durable as its counterpart in full-width construction.

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Elyria, Ohio

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vantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

To Measure, Mix, Feed Chlorine or Other Gases

397. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

Make Water Extra Safe

399. Safe water may be one of the civic improvements your citizens expect soon. Feeders of all types including Hypochlorinators, Reagent Feeders, Dry Chemical Feeders, Chlorinators and Ammoniators for feeding all of the usual chemicals used in sanitation practice. Ask for latest catalogs. Dept. P.W., Wallace & Tiernan Co., Newark 1, N. J.

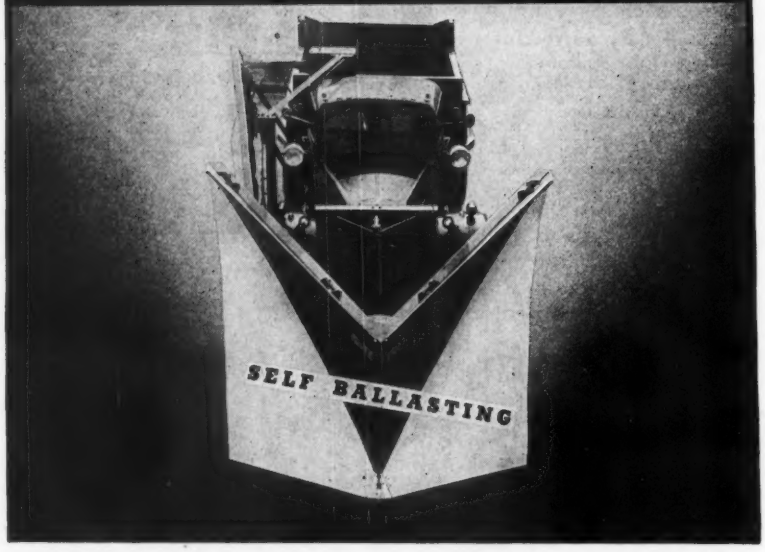
Chem-O-Feeders for Automatic Chemical Feeding

400. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

All Types of Valves, Hydrants And Fittings

413. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Aniston, Ala.

FRINK SNO-PLOWS



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FRINK SNO-PLOWS OF CAN., Ltd., TORONTO, ONT.

Complete Data on Gates, Valves, Hydrants

414. Gate Valves. Double disc bronze mounted, sizes 2" to 72", hand, hydraulic electric or pneumatic operating, rising or non-rising stem. Bulletin X. Address: Rensselaer Valve Co., Troy, N. Y.

88 Page Book Helps Solve Laboratory Problems

423. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 88-page booklet. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

It's Easy to Use This Leak Locator

426. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P, Reading, Mass.

Find Your Leaks In a Jiffy

427. For tracing buried pipes and finding hidden leaks get detail of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6, Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Cast Iron Pipe Handbook—Handy Pocket Size

436. Handbook of Universal Cast Iron Pipe and Fittings, pocket size. 104 pages illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., Dept. P.W., 386 Fourth Ave., New York 16, N. Y.

Cast Iron Pipe and Fittings For Every Need

437. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Dept. P.W., Burlington, N. J.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

How to Make Concrete Pipe on the Job

440. Making concrete pipe on the job to give employment at home is the subject of a booklet sent on request by Quint Wire & Iron Works, 1621 12th St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms.

Concrete Pipe With Greater Elasticity

442. Lock Joint Reinforced Concrete Sewer Pipe, Pressure Pipe, Culvert Pipe, Centrifugal Pipe and Subaqueous Pipe described and illustrated in bulletins available from Lock Joint Pipe Co., Ampere, N. J.

Makes Underground Pipe Installations Easy

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

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MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

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The plus values that come with Roberts Filter equipment are intangibles of long experience, engineering skill and the ability to work with others.

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Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Eliminate Taste and Odor From Your Water

474. Technical pub. No. P.W. 207 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination. Sent free to any operator requesting it.

Have You a Water Conditioning Problem?

481. Installation-tested equipment for complete municipal and industrial systems or individual units. Illustrated and described in latest booklets from Dept. P.W., American Wells Works, Aurora, Ill.

Treating Water With Copper Sulphate

496. "Use of copper sulphate in water treatment plants" contains valuable data on chemicals, dosage, etc. Ferri-floc Ferric Sulphate—a new, valuable booklet P.W. on coagulation for water and sewage treatment plants. Write Tennessee Corporation Atlanta 1, Ga.

How to Stabilize Lime Softened Water

498. Engineering Bulletin describes stabilizing lime-softened water by recarbonation, discusses gas production, washing, compressing, drying, and applying the CO_2. Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Here's Data on All Swimming Pool Needs

508. Well illustrated bulletin describes Filters, Water Softeners, Hydrogen Ion Plants and Complete Equipment for Swimming pools, etc. Copy sent on request by Dept. PW., Chemical Equipment Co., 223 Center Street, Los Angeles 54, Calif.

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We can have Hydrants, Drinking Fountains and Hose Boxes on the job in specified time, provided

Your orders reach us in time to route them through our manufacturing department without a hitch.

Bear in mind that bronze and brass continue scarce (and we won't use inferior metals or combinations of metals).

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SELF-CLOSING ANTI-FREEZING HYDRANT

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LARGE ANTI-FREEZING HYDRANTS 1½" TO 2" INCLUSIVE

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HYDRO-TITE—The dependable self-caulking joint compound for jointing cast iron water mains—uniform—easy to prepare—easy to use—in service for more than 30 years.

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HEADQUARTERS

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WANTED—College graduate engineer with experience for position as Assistant Manager of a municipally owned water works system serving a population of 75,000. State age, qualifications, and experience. Salary $4,200.00 per year. Write Box 102 care Public Works Magazine.

FOR SALE

60,000 Gallon Water Tank—condition as is—where is—located in Wayne, Michigan. For further information, address the Board of Wayne County Road Commissioners, 3800 Barlum Tower, Detroit 26, Mich.

FOR SALE: Two used Fairbanks-Morse turbine pumps, 40 H. P. motors, necessary fittings, mounted on steel barge 12'x30'x4', with cabin. Board of Public Works, 101 S. Main St., St. Charles, Mo.

PERSONAL NEWS

Marion Boriss, formerly sanitary engineer in charge of sewerage and sewage treatment for Jefferson County, Alabama, has been appointed city engineer of Chattanooga, Tenn.

Thomas R. Camp, consulting engineer, announces the formation of a partnership with his associates, Herman G. Dresser and Jack E. McKee, to continue a consulting practice under the firm name of Camp, Dresser & McKee with offices at 6 Beacon Street, Boston. The firm will specialize in water and sewage works and the treatment and disposal of municipal and industrial wastes.

J. Patrick Beacom has been appointed Director of Public Relations for Municipal Enterprises of Morse Boulger Destructor Company, New York.

Harry B. Cummins was recently appointed Manager of the Tar Department of the Tar Products Division of Koppers Company, Inc.

Jack P. Orr and *Preston S. Avery* are now Manufacturer's Representatives for Dresser Manufacturing Division, Bradford, Pa. Mr. Orr will have headquarters in Memphis and Mr. Avery in Atlanta.

Austin K. Thomas, of Chain Belt Company, Milwaukee, has been appointed Sales Manager of the Construction Machinery Division.

JOBS FOR ENGINEERS

Young man with some writing experience and contacts in the water works field wanted to edit a house organ for a waterworks manufacturer. Address HB, care of this magazine.

Graduate sanitary engineer wanted to head Division of Sanitation, Will County Health Department, Joliet, Ill. Salary plus mileage for automobile travel. Write Dr. Cecil A. Z. Sharpe, 21 E. Van Buren St., Joliet, Ill.

Experienced pump design engineer; also field sales manager for pumps wanted. Water and Sewerage field. Write AWW c/o this magazine.

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- Control orifice provides uniform air distribution to diffuser tubes.
- Tubes are located two feet above tank floor . . . blower discharge pressure is proportionately reduced.
- Wide band of fine bubbles prevents coalescing, increases contact volume and contact period between air and mixed liquor.
- The Wide-Band system, having greater air lift effect, develops better tank circulation characteristics.
- Tapered aeration is readily effected . . . adjustment of tube arrangement and air supply can be made to meet oxygen demand.

Operating results from over a hundred successful installations verify these statements. Swing diffusers may be installed to replace obsolete systems. The logical choice for new plants or for expanding present facilities.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

2348 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**

Flush-Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

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APRIL, 1947

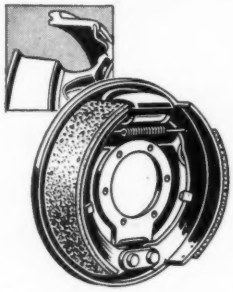
"THINK they last longer? Mister, I KNOW

FORD TRUCKS LAST LONGER!"

That's what Mr. R. G. Colvert of Ardmore, Oklahoma, wrote recently. "One of our Ford Trucks 11 years old," he added, "has gone over 250,000 miles and it's still on the job, with lots of good miles in it!"

ONE big reason—FORD BRAKES STAND UP!

The wide, heavy, cast drum surfaces of Ford Brakes are non-warping and score-resistant. They are interlocked and fused with steel drum discs during casting, providing great strength and reducing weight. The two shoes are independently anchored, each shoe being actuated by its own hydraulic piston. Adjustment is extremely simple and entirely external. Brakes are exceptionally stable in adjustment. Entry of water and dust is minimized by closely fitted tongue-and-groove design, where edges of drums meet backing plates. Ford brake design promotes long lining life, consistent performance, extra-safe stopping ability and easy pedal pressure.



Ford

Bulk construction materials hauling is a field where Ford Truck stamina pays off in long life and low-cost maintenance. This heavy duty Ford Truck is equipped with a Fabco Dual Drive unit and a 6- to 8-yard dump body and hydraulic hoist by Anthony Co., Streator, Illinois.

ONLY FORD GIVES YOU *ALL* THESE LONG-LIFE FEATURES: Your pick of power—the great V-8 or the brilliant Ford Six—extra-strength frames, with siderails *doubled* in heavy duty models—new Flightlight, 4-ring, oil-saving pistons—full-floating and ¾-floating axles, with axle shafts free of weight-load . . . more than fifty such endurance-engineering features in all. It's because of this long-life construction that *of all trucks 14 years old or older on the road today, there are more Ford Trucks than all other makes combined!* More than 100 body-chassis combinations to choose from. Ask your Ford Dealer to show you!

MORE FORD TRUCKS IN USE TODAY THAN ANY OTHER MAKE!

When you need special information—consult the classified READERS' SERVICE DEPT., pages 69-73